

Marlborough Creek Erosion Mitigation Assessment

6038 Ottawa Street

Ottawa (Richmond), Ontario



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1 Introduction

GEO Morphix Ltd. (GEO Morphix) was retained by David Schaeffer Engineering Ltd. (DSEL) to complete a fluvial geomorphological assessment of existing conditions along Marlborough Creek to support the proposed development at 6038 Ottawa Street in the City of Ottawa (Richmond), Ontario. The proposed development includes residential, commercial and natural land uses and is approximately 67 hectares in area. Additionally, a stormwater management pond for the development, located east of Ottawa Street, is proposed to outlet to Marlborough Creek.

A preliminary Fluvial Geomorphology Report was submitted on February 26, 2021, and included a review of background reports and mapping, watercourse reach delineation, a review of recent and historical aerial photographs, and delineation of a preliminary meander belt width. The preliminary report (GEO Morphix Ltd., 2021) was based on a desktop assessment only. In April 2021, field reconnaissance was completed to confirm existing site conditions and finalize the geomorphic assessment. The field investigation verified our findings from the desktop assessment and confirmed there were no changes to the initial findings. A complete summary of the geomorphic assessment was provided in the updated Meander Belt Width Report (GEO Morphix Ltd. 2025).

In support of the proposed SWM pond, an erosion threshold and erosion exceedance assessment based on the results of the geomorphological assessment are provided in this report. The overall objective of the current study is to evaluate the SWM plan for the proposed development to determine its effectiveness in mitigating changes to erosion potential along the receiving watercourse. The following tasks were completed as part of the assessment:

- Review of existing documentation related to the subject lands, including topography, physiography, and geology mapping, as well as previously completed studies
- Delineate watercourse reaches based on a desktop assessment and confirm reach delineation through geomorphic field observations
- Conduct field reconnaissance using standard, industry-accepted tools such as the rapid geomorphic assessment (RGA) and rapid stream assessment technique (RSAT) to evaluate existing instream and riparian conditions along the downstream receiving reaches (i.e., evidence of ongoing channel processes, active erosion/deposition, or potential channel instability)
- Complete one detailed geomorphological assessment in the potential zone of impact along the receiving watercourse
- Complete the erosion threshold assessment based on detailed assessment results to determine the limiting erosion threshold value and inform the erosion exceedance analysis
- Complete the erosion exceedance analysis using the determined erosion threshold value to inform stormwater mitigation strategies and SWM pond sizing and release rates to address erosion mitigation requirements

2 Desktop Assessment

2.1 Background Information

The subject property is within the Rideau Valley watershed, and more specifically, the Jock River subwatershed (Richmond catchment). The Jock River-Richmond subwatershed drains an area of approximately 31 square kilometres with approximately 60 km of channel length (including both Jock River and tributaries; RVCA, 2016). The dominant land cover within the Jock River-Richmond catchment is crop and pasture (47%) followed by woodlands and wetlands at 16% and 15%, respectively (RVCA, 2016).

Immediately adjacent to the subject property, Marlborough Creek flows in a northern direction, originating north of Dobbs Road and flows towards its confluence with the Jock River, located just south of the intersection of Old Richmond Road and Eagleson Road. The length of Marlborough Creek that was assessed is approximately 2.5 km, originating from McBean Street, and flowing alongside private property and agricultural fields before crossing under Ottawa Street. Between Ottawa Street and the railroad tracks, the watercourse becomes a pond and narrows again as it crosses under the rail line. The channel then flows parallel to the rail line upstream of Eagleson Road where the floodplain widens and



is heavily vegetated. The dominant land use surrounding the subject reaches is agriculture and residential.

For reference, a study area mapping is provided in **Appendix A.**

2.2 Physiography and Surficial Geology

Geology and physiography act as primary controls on channel morphology as they influence the hydrological and sediment characteristics of the channel system. Channel morphodynamics are governed by the channel's flow regime and the availability and type of sediments within the stream corridor. These factors are explored as they offer insight into existing conditions and potential changes to the channel that may result from the proposed development. Understanding local surficial geology is important for determining appropriate erosion thresholds, as the stability of the channel banks and bed depends on the composition of soils, sediment, and underlying parent materials (MNR, 2002).

The subject property is located in the Clay Plains physiographic region of Ontario (Chapman and Putnam, 2007). The surficial geology associated with Marlborough Creek largely contributes to its planform and channel stability. The surficial sediments at the subject lands are characterized as fine-textured (clay, silt) glaciomarine deposits, deposited in the offshore environment of the Champlain Sea during the Wisconsinan Glaciation (OGS, 2010). Surficial deposits and substrate within the subject property include silt and clay, minor sand, and gravel (OGS, 2010). Upstream of the subject lands, Marlborough Creek flows through lands characterized by Paleozoic bedrock and thin deposits of glacial till (OGS, 2010).

Fine-textured sediments deposited within offshore glacio-marine or marine environments, like those observed at surface within the subject lands, may be subject to sensitivity and erosion due to high pore pressure and low shear strength when disturbed (Mayne, Cargill & Miller, 2019; Brooks, 2019). Disruptions, such as erosional slope failure, construction activities, or seismic activity, may trigger further rotational slope failures. While slope failures are well documented within Eastern Ontario and The City of Ottawa (Brooks, 2019), no such failures have been documented along Marlborough Creek, nor were any visible slump scars identified during the desktop review of LiDAR data for the area. Additionally, Marlborough Creek occurs within a generally unconfined system and has limited sinuosity, further limiting the likelihood of disruptions along the outside of meander bends.

For reference, a map of local surficial geology is provided in **Appendix A.**

3 Watercourse Characteristics

3.1 Reach Delineation

Reaches are homogeneous segments of channel used in geomorphological investigations. Reaches are studied semi-independently as each is expected to function in a manner that is at least slightly different from adjoining reaches. This method allows for a meaningful characterization of a watercourse as the aggregate of reaches, or an understanding of a particular reach, for example, as it relates to a proposed activity. Reaches are typically delineated based on changes in the following:

- Channel planform
- Channel gradient
- Physiography
- Land cover (land use or vegetation)
- Flow, due to tributary inputs
- Soil type and surficial geology
- Historical channel modifications

Reach delineation follows scientifically defensible methodology proposed by Montgomery and Buffington (1997), the Toronto and Region Conservation Authority (2004) and others. watercourse reaches were delineated adjacent to and downstream of the subject site based on a desktop assessment of available



data (e.g., MNRF stream layer, surficial geology, historical and recent aerial photographs, topographic

Reach **MC1** was previously named and delineated for the 2021 Preliminary Fluvial Geomorphology Report (GEO Morphix Ltd., 2021). An additional 5 reaches were delineated downstream (**MC2**, **MC3**, **MC4**, **MC5** and **MC6**). Reach mapping is provided in **Appendix A** for reference.

3.2 Reach Observations

Field investigations were completed on July 8th, 2025 and included the following tasks:

- Describe riparian conditions
- Estimate bankfull channel dimensions
- Characterize bed and bank material composition and structure
- Collect observations of erosion, scour, or deposition
- Compile photographs to document the watercourses, riparian areas and/or valley, surrounding land use, and channel disturbances such as crossing structures

The observations and measurements collected during field activities are summarized in **Table 1**. Field descriptions are supplemented and supported with representative photographs, which are included in **Appendix B**. Field observations are provided in **Appendix C**.

Table 1: Summary of general reach characteristics.

Reach Name	Avg. Bankfull Width (m)	Avg. Bankfull Depth (m)	Riffle Substrate	Pool Substrate	Dominant Riparian Condition	Confinement	Notes
MC1¹	7.4	Too deep	Gravel, Cobble	Clay/Silt, Sand, Gravel	Trees, grasses	Partially Confined	 Reach heavily encroached with cattails Large boulders noted within the floodplain No evidence of erosion noted
MC2²	N/A	N/A	Clay/Silt		Trees, shrubs	Unconfined	No riffle pool formation, all runs Dense instream vegetation Wetted depth >1.0 meters, sediment depth of >0.75m at start of reach and 0.3m near end of reach No undercutting, low bank angle
MC3³	4.1	0.22	Clay/Silt, Sand, Gravel		Trees, shrubs, grasses, herbaceous plants	Partially Confined	Two instances of exposed mature tree roots Low and generally stable banks CN railway acts as right bank of channel Substrate ranged from silt to large cobble with 2 riffles along straightened reach Sediment depth at start of reach of 0.15m and 0.64m at end of reach likely due to wetland/swamp like conditions at end of reach



Reach Name	Avg. Bankfull Width (m)	Avg. Bankfull Depth (m)	Riffle Pool Substrate Substrate	Dominant Riparian Condition	Confinement	Notes
MC4 ²	N/A	N/A	Clay/Silt	Trees, shrubs	Partially Confined	 Channel is heavily vegetated with cattails and European frogbit No velocity, sediment depth regularly exceeds double wetted depth Wetted depth 0.29m at start of reach and 0.38m at end of reach Sediment depth 0.55m at start of reach, >1.0m at end of reach
MC5²	N/A	N/A	Clay/Silt	Trees, shrubs	Unconfined	 Right bank forested and left bank with a minimal buffer due to agricultural field Wetted depth ~0.4m, sediment depth >0.6m No flow, no defined channel Dense instream vegetation covers 100% of the reach, cattails about 2m tall
MC6 ²	N/A	N/A	Clay, Silt, Sand	Trees, shrubs, grasses	Unconfined	 Straight channel, no flow Small culvert under farm road crossing at end of reach before confluence with Jock River Riparian vegetation very limited due to agricultural fields on both banks Dense instream duckweed vegetation

¹Observations from the 2021 Meander Belt Width Report (GEO Morphix Ltd., 2021)

Reach MC1 was mostly unconfined, but several constructed berms flanking its floodplain (e.g., between the two culverted crossings on private property, upstream of the Ottawa Street crossing), create a localized area of partial confinement. Generally, there was approximately 2 meters rise between bed of the channel and the adjacent tableland, connected by moderately sloped banks and a well-connected floodplain. The channel was slightly sinuous (1.06-1.30) within a linear floodplain. Portions of Reach MC1 were well-defined, while the majority of the channel exhibited poor bed and bank definition. Where defined, the average channel width is approximately 2.5 metres and encroached upon by riparian vegetation, with occasional riffle features and vegetated bars and islands. Pool features, averaging approximately 11.5 metres width, were observed downstream of the McBean Street crossing and both upstream and downstream of the two private channel crossings located mid-reach. The bed substrate was moderately well sorted, with riffles consisting of gravel and cobble-sized clasts, and pool substrate composed of clay, silt, sand, and gravel-sized clasts; larger cobble and boulder clasts occurred along the floodplain but appeared to have been mechanically placed (i.e., removing stones to prepare land for cultivation). Banks were entirely covered by established and stable riparian vegetation. Wetland submergent and emergent vegetation occurred continuously along the floodplain of the reach, occasionally spanning the channel and causing it to become undefined. Beyond the wetland-occupied floodplain, riparian vegetation becomes less continuous as the riparian vegetation transitions to established trees (5-30 years) and grass species.

²Bankfull measurements were not collected due to poor bankfull indicators and lack of channel definition

³Bankfull dimensions from detailed assessment survey



Reach **MC2** was situated within an unconfined valley setting and was characteristic of a wide, stagnant pond. The riparian vegetation was composed of established trees, and woody debris was noted along the banks. Instream vegetation was dense, and the surface of the water was completely covered by rooted emergent and floating vegetation. The banks were composed of silt and were low and well-vegetated. No signs of erosion were noted. The bed was composed of deep silt (up to 0.75m) and organic material. The channel was approximately 17m wide along the reach but narrows as it flows under the railway tracks and transitions into reach **MC3.**

Reach **MC3** flows within a partially confined valley system due to the railway tracks that run along the right bank. Along the left bank, the channel was unconfined, with a measured bankfull height of approximately 0.22m. The bank's slopes were shallow (0-30°) and stable. The channel appears to have been straightened, most likely to accommodate the construction of the railway prior to 1954 (GEO Morphix, 2021). Generally, the bed morphology was composed of runs, with few pools and riffles noted, and minimal flow. The bed substrate was composed of clay/silt, sand and gravel with observations of cobbles in the riffles. Instream vegetation was prominent, including duckweed, cattails and algae. The banks were well vegetated, composed of mature trees and grasses along the left bank and grasses along the right bank adjacent to the railway. No signs of erosion were noted, and siltation was noted in a few isolated areas.

Reach **MC4** flows within a partially confined valley setting due to agricultural fields located along the edges of the floodplain. The channel exhibited low sinuosity as it flowed through a broad, grassy floodplain. The bankfull width and depth were difficult to discern throughout the reach as there was poor channel definition, and vegetation encroachment was heavy; however, estimated bankfull width and depths were 17 m and 0.88 m, respectively. No pools or riffles were identified throughout the reach and at the time of assessment, there was no flow. The bed substrate was composed of silt, up to 1m deep along the downstream extent. Instream vegetation was dense and composed of algae, floating, and rooted emergent vegetation that covered up to 90% of the surface. The banks, where discernible, were well vegetated and stable. No signs of erosion were noted, and deep pockets of silt were noted; however, it is characteristic of wide vegetated floodplains as observed.

Reach **MC5** is situated within an unconfined valley setting, and flows through a poorly defined channel which is heavily encroached upon by vegetation within a wide floodplain. Bankfull width and depths were difficult to identify due to the lack of definition; however, the floodplain was estimated to be 40m across and channel depth to be 0.3-0.4m. There were no pools or riffles identified, and at the time of the assessment, the flows were stagnant. The bed substrate was composed of deep silt, up to 0.60m deep. Instream vegetation was dense and composed of rooted emergent vegetation, which covered approximately 90% of the reach. An established forest was observed along the right edge of the floodplain, and along the left was a narrow grassy buffer between the channel and an agricultural field. No signs of erosion were noted throughout the reach, and siltation was observed; however, it is characteristic of a wide vegetated floodplain.

Reach **MC6** exhibited similar characteristics to **MC5**. The reach is situated within an unconfined valley system and extends through the wide floodplain to its confluence with the Jock River. Defined bankfull widths and depths were difficult to observe; however the floodplain was estimated to be 27m wide and 1.6m deep. One instance of a riffle-pool sequence was observed towards the downstream extent of the reach; otherwise, the channel exhibited wetland characteristics with stagnant water and abundant aquatic vegetation. The bed substrate was composed of silt, up to 0.30m deep, and instream vegetation, including cattails and floating instream vegetation was dense. Riparian vegetation along the edges of the floodplain was limited due to adjacent agricultural fields. A small culvert conveys flow under a narrow farm access crossing, immediately upstream of the confluence with the Jock River. No erosion was observed along the length of the reach.

3.3 Rapid Assessment Results

Channel instability was objectively quantified through the application of the Ontario Ministry of the Environment's (2003) Rapid Geomorphic Assessment (RGA). Observations were quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel



widening, and planimetric adjustment. The index produces values that indicate whether a channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40), or adjusting (score >0.41).

The Rapid Stream Assessment Technique (RSAT) was also employed to provide a broader view of the system as it considers the ecological function of the watercourse (Galli, 1996). Observations were made of channel stability, channel scouring or sediment deposition, instream and riparian habitats, and water quality. The RSAT score ranks the channel as maintaining a poor (<13), fair (13-24), good (25-34), or excellent (35-42) degree of stream health.

Reaches were also classified according to the Downs (1995) Channel Evolution Model. The Downs Model describes the successional stages of a channel because of perturbation, namely hydromodification. Understanding the current stage of the system is beneficial as this allows one to predict how the channel will continue to evolve or respond to an alteration to the system.

These observations and measurements are summarized below and in **Table 2**.

Table 2: Summary of rapid assessment results.

	RG	iA (MOE, 20	001)				
Reach Name	Score	Condition	Dominant Systematic Adjustment	Score	Condition	Limiting Feature(s)	Down's (1995) Classification
MC1*	0.140	In Regime	Widening	30	Good	Riparian Habitat Conditions	s/d
MC2	0.107	In Regime	Aggradation	20	Fair	Physical Instream Habitat, Riparian Habitat Conditions	D
мсз	0.137	In Regime	Aggradation	22	Fair	Riparian Habitat Conditions	D
MC4	0.137	In Regime	Aggradation	23	Fair	Riparian Habitat Conditions	D
мс5	0.140	In Regime	Aggradation	20	Fair	Riparian Habitat Conditions	D
MC6	0.140	In Regime	Widening	24	Fair	Riparian Habitat Conditions	D

^{*}Observations collected in 2021 for the updated Meander Belt Width Report (GEO Morphix Ltd., 2025)

Reach MC1 was assigned an RGA score of 0.140, indicating the reach was in regime. The dominant geomorphological indicator was evidence of widening due to the observations of fallen and leaning trees and the occurrence of large organic debris. However, it is important to note that falling and leaning trees were likely attributed to human modification adjacent to the watercourse rather than from active channel processes. **Reach MC1** had an RSAT score of 30, or "good". One limiting factor, riparian habitat conditions, was attributed to the narrow riparian area outside of the well-connected flood plain, which was predominantly wooded vegetation (i.e., trees) and fragmented in some areas.

Reach MC2 was assigned an RGA score of 0.107, indicating that the reach is in regime. The dominant geomorphological indicator was aggradation due to observations of siltation in pools and poorly sorted



bed materials. It important to note that only minor instances of these indicators were observed. The reach received an RSAT score of 20, or fair. The limiting feature was physical instream habitat and riparian habitat conditions due to a lack of canopy coverage and non-woody riparian edges.

Reach MC3 was assigned an RGA score of 0.137, indicating that the reach is in regime. Aggradation was the dominant systematic adjustment due to observations of siltation in pools and poorly sorted bed materials. Similar to **MC2**, only minor instances of these indicators were observed. An RSAT score of 22, or fair was assigned. The limiting feature was riparian habitat conditions due to the lack of woody vegetation.

Reach MC4 was assigned an RGA score of 0.137, indicating that the reach is in regime. The dominant systematic adjustment was aggradation. Minor instances of siltation in pools and poorly sorted bed materials were observed. An RSAT score of 23, or fair was assigned to the reach. The limiting feature was riparian habitat conditions due to a lack of woody vegetation within the riparian edges.

Reach MC5 received and RGA score of 0.140, indicating that the reach is in regime. The dominant systematic adjustment was aggradation due to observations of siltation in the pools. The reach received an RSAT score of 20 or fair. The limiting feature was riparian habitat conditions due to the lack of woody riparian vegetation and canopy coverage.

Reach MC6 was assigned an RGA score of 0.140 indicating that the reach is in regime. The dominant systematic adjustment was widening due to fallen and leaning trees. Note there were very few instances of this indicator noted. An RSAT score of 24, or fair was assigned and the limiting feature was riparian habitat conditions due to the lack of woody riparian vegetation and poor canopy coverage.

3.4 Detailed Geomorphological Assessments

A detailed assessment was completed for the most erosion-sensitive reach along Marlborough Creek. Based on results from the rapid geomorphic assessments, Reach MC3 was selected for detailed assessments, it is located downstream from the proposed SWM Pond, exhibits minor evidence of bed erosion, and was well-defined in comparison with the other assessed reaches. Reaches MC2 and MC4-MC6 were all determined to be in regime, with no evidence of active erosion or channel adjustment and with portions of the reaches noted to be poorly-defined. While evidence of erosion was observed along Reach MC1, the majority of the reach was poorly-defined. Additionally, the SWM Pond is proposed to discharge at the downstream extent of Reach MC1. Thus, the detailed assessment was completed for Reach MC3 on July 9th, 2025.

Detailed geomorphological assessments provide bankfull channel characteristics for the purpose of defining the erosion threshold, and include the following field activities:

- Long-profile, level survey of the channel centre line
- Detailed cross-sectional surveys at multiple locations along the subject channel reach
- Detailed instream measurements at each cross-section location including bankfull channel geometry, riparian conditions, bank material, bank height/angle, and bank root density
- Bed material sampling at each cross-section following a modified Wolman's (1954) Pebble Count Technique and/or substrate samples
- · Velocity and discharge measurements at select representative cross-sections

Based on results from the detailed assessment, **Reach MC3** was characterized as a straightened channel flowing through a partially confined valley, with a riparian zone consisting of a continuous coverage of established trees, shrubs and grasses. The channel was dominated by runs, and the banks were generally low and there were minor instances of scour. Siltation was noted in a few pools. Bed substrate ranged from clay/silt to cobbles.

A summary of measured and computed values is presented in **Table 3** and comprehensive detailed assessment summaries are provided in **Appendix D.**



Table 3: Detailed assessment bankfull channel parameters for Reach MC3.

Channel parameters	Reach		
Chamier parameters	мсз		
Measured			
Average bankfull channel width (m)	4.13		
Average bankfull channel depth (m)	0.22		
Channel bed gradient (%)	0.28		
Bankfull gradient (%)	0.49		
D ₅₀ (mm)	0.98		
D ₈₄ (mm)	4.25		
Manning's n roughness coefficient	0.040		
Computed			
Bankfull Discharge (m³/s)*	0.66		
Average bankfull velocity (m/s)*	0.73		

^{*}Based on Manning's Equation

4 Erosion Threshold Assessment

Erosion thresholds are used to determine the magnitude of flow required to potentially entrain and transport bed and/or bank material. As such, they are used to inform erosion mitigation strategies in channels influenced by conceptual flow and stormwater management plans. An erosion threshold was modelled from detailed field observations of **Reach MC3** along Marlborough Creek. This reach was selected for the assessment, as it was determined to be relatively erosion-sensitive within the potential zone of impact downstream of the proposed SWM outlet. The erosion threshold is the theoretical point, typically expressed as a critical discharge or shear stress, at which entrainment of sediment would occur based on the morphology of the channel and characteristics of the bed and bank materials. Due to variability between bed and bank composition and structure, erosion thresholds are determined for both bed and bank materials. The lower of the bed and bank erosion thresholds is adopted, as it provides the more conservative and limiting estimate of erosion potential. The results of the erosion threshold assessment are provided in **Table 3** below.

4.1 Methods

Erosion threshold targets are determined using different methods depending on the observed sediment characteristics of the channel. For example, thresholds for non-cohesive sediments are commonly estimated using a shear stress approach, similar to that of Miller et al. (1977), which is based on a modified Shield's curve. A velocity approach could also be applied (Villard & Parish, 2003). For cohesive materials, a method such as that described by Komar (1987), or empirically derived values such as those compiled by Fischenich (2001), Chow (1959) or Julien (1994), could be applied. Villard and Parish (2003) emphasize the importance of selecting methods that reflect local sediment conditions and integrating them into site-specific geomorphic assessments.



An erosion threshold is quantified based on the bed and bank materials and local channel geometry, in the form of a critical discharge (Villard & Parish, 2003; TRCA 2012). Theoretically, above this discharge, entrainment and transport of sediment can occur. To determine this discharge, the velocity, U, or Shear Stress, τ , is calculated at various depths for a representative cross-section until the average velocity or shear stress slightly exceeds the critical threshold of the bed material. The velocity is determined using Manning's approach, where Manning's n value is visually estimated through a method described by Acrement and Schneider (1989) or calculated using the Limerino (1970) approach. A Manning's n value of 0.045 was used for the assessment, based on the physical characteristics of the subject reach. The velocity is mathematically represented as:

$$U = \frac{1}{n}d^{2}/_{3}S^{1}/_{2}$$
 [Eq. 1]

where, d is depth of water, S is channel slope, and n is the Manning's roughness.

The shear stress is determined using the depth-slope product, which can be applied to the bed of open channels containing fluid undergoing steady flows. The shear stress is mathematically represented as:

$$au_0 = d
ho g S$$
 [Eq. 2]

Where, τ_0 is shear stress, d is the water depth, ρ is water density, g is acceleration due to gravity, and S is the channel slope.

Because only 75% of bed shear stress applies to channel banks in uniform cross sections (Chow, 1959), the erosion threshold is scaled appropriately for these materials.

4.2 Results

Based on results from the detailed assessment for **Reach MC3**, bed substrate consisted primarily of clay and silt with some sand and gravel and isolated embedded cobbles present throughout. From the criteria for fine sandy loam defined by Julien (1998), a critical velocity of 0.45 m/s was determined for bed materials. This resulted in a crucial discharge of $0.190 \text{ m}^3/\text{s}$. Bank substrate was composed of loose cohesive silty/sandy clay, based on visual observations and on field measurements using a torvane and a penetrometer. A critical shear stress of 4.79 N/m^2 was determined for bank materials, based on the criteria defined by Chow (1959) for loose sandy clay. This yielded a critical discharge of $0.175 \text{ m}^3/\text{s}$ for bank materials. As the lesser of the two values a critical discharge of $0.175 \text{ m}^3/\text{s}$ for bank materials was adopted as the erosion threshold for **Reach MC3**.



Table 4: Channel parameters and erosion threshold results.

Channel Parameters	Me	C3		
Average bankfull channel width (m)	4.13			
Average bankfull channel depth (m)	0.22			
Bankfull gradient (%)	0.4	49		
D ₅₀ (mm)	0.0	98		
D ₈₄ (mm)	4.3	25		
Manning's n roughness coefficient	0.0)40		
Pre-development drainage area (ha)*	560	6.5		
Bankfull discharge (m³/s)**	0.0	66		
Bankfull velocity (m/s)**	0.	73		
Erosion Threshold	<u> </u>			
	Bed	Banks		
Material	Fine sandy loam	Loose sandy clay		
Method	(Julien, 1998)	Chow (1959)		
Critical velocity (m/s)	0.45			
Apparent shear stress (N/m²)	6.74			
Critical shear stress (N/m²)		4.79		
Apparent velocity (m/s)		0.33		
Critical depth (m)	0.20	0.19		
Critical discharge (m³/s)	0.190	0.175		
Limiting erosion threshold (m³/s)	0.175			
Unitary erosion threshold (m³/s/ha)	0.00	031		

^{*}Drainage area provided by JFSA (2025)

5 Erosion Exceedance Assessment

In support of the proposed Stormwater Management (SWM) plan, an erosion exceedance analysis was completed for the receiving watercourse (CVC, 2015; TRCA, 2012). The application of erosion threshold analysis for evaluating the effectiveness of stormwater management facilities in mitigating changes in downstream erosion potential is a concept developed with support by a co-author of the present report (P. Villard) and detailed in guidelines prepared on behalf of the Credit Valley Conservation Authority and Toronto and Region Conservation Authority and in Villard and Parish (2003).

Under post-development conditions, overland drainage within the Marlborough Creek catchment overlapping with the subject lands will be directed to an on-site SWM facility. This facility will outlet to **Reach MC1**, located 300 m upstream of **Reach MC3**. **Reach MC3** was selected for analysis as results from desktop and field assessments found it to be the most erosion-sensitive and accessible reach downstream of the SWM Pond outlet within the potential zone of impact.

Using the results from the erosion threshold analysis and hydrological simulation modelling provided by JFSA (2025) for existing and proposed conditions, erosion exceedance analyses to evaluate the potential for changes in the amount of erosion within the watercourse were completed with our in-house Erosion Exceedance Model. The most relevant erosion exceedance indices are summarized below:

- 1) Cumulative time of exceedance (tex)
- 2) Number of exceedance events

^{**}Estimated bankfull discharge and velocity calculated from four representative cross-sections



- 3) Cumulative effective volume (CEV)
- 4) Cumulative effective work/stream power index (CEWI)

These indices were developed in response to limitations of traditional peak flow-based stormwater design (Villard & Parish, 2003; Villard & Ness, 2006). They have been applied in various southern Ontario Jurisdictions, including Conservation Halton (CH), Toronto Region Conservation Authority (TRCA), Credit Valley Conservation (CVC). These indices, as a product, provide an evaluation of the number of events, as well as the duration and magnitude of sediment transport (Villard & Ness, 2006). We note that the most relevant indicator is the cumulative effective stream power, as it reflects both the duration and magnitude of erosion exceedance events.

Time of exceedance, number of exceedances, average effective discharge, and cumulative effective volume can be calculated from the discharge record and the established critical discharge. The cumulative time of exceedance is simply the summed duration of time where discharge exceeds the established erosion threshold, and the number of exceedances is the count of erosion exceedance events throughout the discharge record. The cumulative time of exceedance simply quantifies the duration that the threshold is exceeded, but does not provide information on the work or erosive force of flows once the thresholds are exceeded (TRCA, 2012). The average effective discharge represents the average magnitude of discharge exceeding the erosion threshold during a given erosion event, whereas the cumulative effective volume represents the total discharge volume that exceeds the erosion threshold throughout the modelled discharge record.

For more relevant indicators, namely the cumulative effective work index, channel hydraulic information is required. Our model applies discharge to a characteristic cross-section. Using a Manning's approach, the discharge at each time step in the continuous hydrological model is converted into a velocity, depth of flow, shear stress, and/or stream power. These parameters are calculated based on field measurements of slope, cross-sectional geometry and channel roughness. This provides analysis that is site-appropriate and specific.

The post-development hydrological modelling reflects changes to the hydrological regime resulting from the proposed development and includes the implementation of SWM measures. Continuous flow data for **Reach MC3** was modelled by JFSA (2025) using hourly rainfall data, and was provided in the form of continuous annual models for the years 1967-2016 at 5-minute timesteps. The hydrological simulation data for existing and proposed conditions was analyzed to calculate the aforementioned erosion indices. A full series of post- and pre-development hydrographs, overlain with the respective erosion threshold values, are provided in **Appendix F**, for reference.

5.1 Methodology

To calculate erosion indices, both velocity and shear stress were calculated at each time step. Through an iterative process, water depth and velocity were calculated for each discharge passing through a representative cross-section. The cross-section is divided into floodplain and bankfull sections. The cross-section is further broken into panels. Velocity, U, is calculated for each panel using the Manning's approach, consistent with practices outlined in Chow (1959) and employed in TRCA (2012). This is a conservative approach as it allows dissipation of flood energy in the floodplain.

This is a conservative approach as it allows dissipation of flood energy in the floodplain, reducing overestimation of erosive potential.

The total discharge, Q_T at each time step is based on the summation of the discharge of all panels, Q_i , such that:

$$Q_{T=}\sum Q_i$$
 [Eq. 3]

Each Q_i represents discharge through a panel (which is set at 10 percent of the cross-section). Q_i is defined as:

$$Q_i = U_i w_i d_i$$
 [Eq. 4]



where, U_i , w_i and d_i are velocity, width and depth for each panel. The discharge for each panel was then summed to give a total discharge. This is more accurate than using average cross-sectional dimensions of a simple trapezoidal channel, as the bed is usually irregular, and a panel approach more accurately represents the true cross-sectional area (Villard & Parish, 2003).

For each event, the discharge is converted into a maximum depth and average velocity. The maximum depth is used to calculate a maximum bed shear stress, $\tau_{o_{max}}$ based on:

$$au_{
m omax} = d_{
m max}
ho g S$$
 [Eq. 5]

where, d_{max} is the maximum water depth, ρ is water density, g is acceleration due to gravity, and S is the channel slope.

Cumulative total work, ω_{tot} is defined as:

$$\omega_{\mathrm{tot}} = \sum \tau_{0_{\mathrm{max}}} . U_{\mathrm{avg}} . \Delta t$$
 [Eq. 6]

where, U_{avg} is average velocity (Q_{tot}/A_{tot} , where A_{tot} is wetted area), while cumulative effective work index (α_{eff}) is defined by:

$$\omega_{\text{eff}} = \sum \tau - \tau_{cr} \cdot U \cdot \Delta t, \, \omega < 0 = 0$$
 [Eq. 7]

where, τ_{cr} is the critical shear stress.

Time of exceedance t_{ex} defined as:

$$t_{\rm ex} = \sum \Delta t \ \text{for} \ (Q_T > Q_{\rm threshold})$$
 [Eq. 8]

where, $Q_{\text{threshold}}$ is the discharge at the erosion threshold.

The cumulative effective volume (CEV) is defined as:

$$CEV = \sum Q \text{ (for } Q > Q_{threshold})$$
 [Eq. 9]

5.2 Results

Erosion exceedance modelling results indicate that the proposed stormwater management plan effectively mitigates the risk of increases in erosion potential within the receiving watercourse. Results from the continuous hydrological modelling demonstrate a negligible change in erosion potential under post-development conditions. We note that the cumulative effective work index (∞ eff; CEWI) is considered the most relevant index with respect to erosion potential, as it reflects both the flow magnitude and exceedance duration of a given erosion event. Results over +/-5% are considered to be significant enough to result in a measurable change in erosion potential within the receiving watercourse. The cumulative effective discharge (CED) indicator is of secondary relevance, representing the total discharge volume exceeding the established critical discharge throughout the modelling record. The predevelopment and post-development hydrographs are included in **Appendix F**. **Table 5** summarizes the results of the erosion exceedance assessment based on the continuous streamflow data provided by JFSA (2025).



Table 5: Erosion exceedance results for Reach MC3.

мсз								
Scenario Cumulative (1960-1999)		CEV (m³)	ω _{eff} (N/m²)	t _{ex} (hrs)	# Of Exceedances			
	(PRE)	13,476,833	28,542	7,321	591			
$Q_{crit} = 0.175$	(POST)	13,422,290	29,952	8,906	564			
	Change (%)	-0.40	4.94	21.64	-4.57			

The cumulative effective discharge volume (CED) is expected to decrease by less than 1% under post-development conditions, while the cumulative effective work index (CEWI) is expected to increase by 5%. The duration of exceedances will increase moderately to 22%, while the number of exceedance is predicted to decrease by 5%. The observed decrease in the number of exceedances and associated increase in duration is associated with a post-development reduction in peak flow and corresponding increase in drawdown time, as observed in the hydrographs provided in **Appendix F**. Despite the moderate increase in the duration of exceedance events, the two most relevant erosion indices remain within \pm 0 of existing conditions under post-development conditions. This demonstrates that the increase in erosion potential within the receiving watercourse is not expected to measurably impact the pattern and rates of erosion within the receiving watercourse. Thus, results from the erosion exceedance modelling demonstrate that the proposed SWM plan is not anticipated to impact Marlborough Creek negatively.

6 Summary

A fluvial geomorphology and erosion assessment was conducted in support of future development at 6038 Ottawa Street located east of the Canadian National Railway in Richmond, Ontario. One (1) SWM Pond is proposed to service the development, discharging to Marlborough Creek, a tributary to the Jock River. Based on results from desktop and field assessments, **Reach MC3** was identified as the most erosion-sensitive reach within the receiving watercourse. A detailed assessment was completed along Reach **MC3** to inform the erosion threshold analysis, which determined a critical discharge of 0.175 m³/s. Using the defined erosion threshold, an erosion exceedance analysis was completed using modelled stream flow discharge data for long-term continuous hydrological simulations (JFSA, 2025). An evaluation of pre- to post-development erosion metrics indicated that the proposed SWM facilities effectively address any potential erosion risk for the receiving watercourses. The SWM strategy results in no significant change in erosion potential within **MC3**.

We trust this report meets your current requirements. Should you have any questions, please contact us.

Respectfully submitted,

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Director, Principal Geomorphologist

Jan Franssen, Ph.D

Senior Watershed Scientist, Technical Lead



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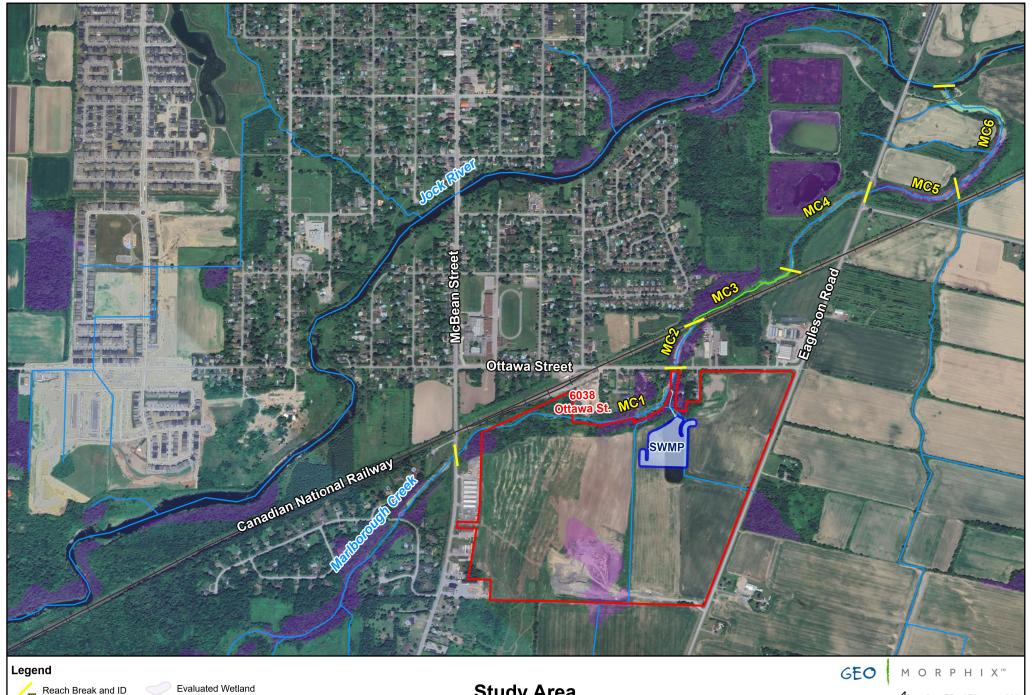
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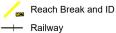
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Appendix A: Site Maps







Detailed Assessment

Proposed Outlet Channel

Not Evaluated Wetland

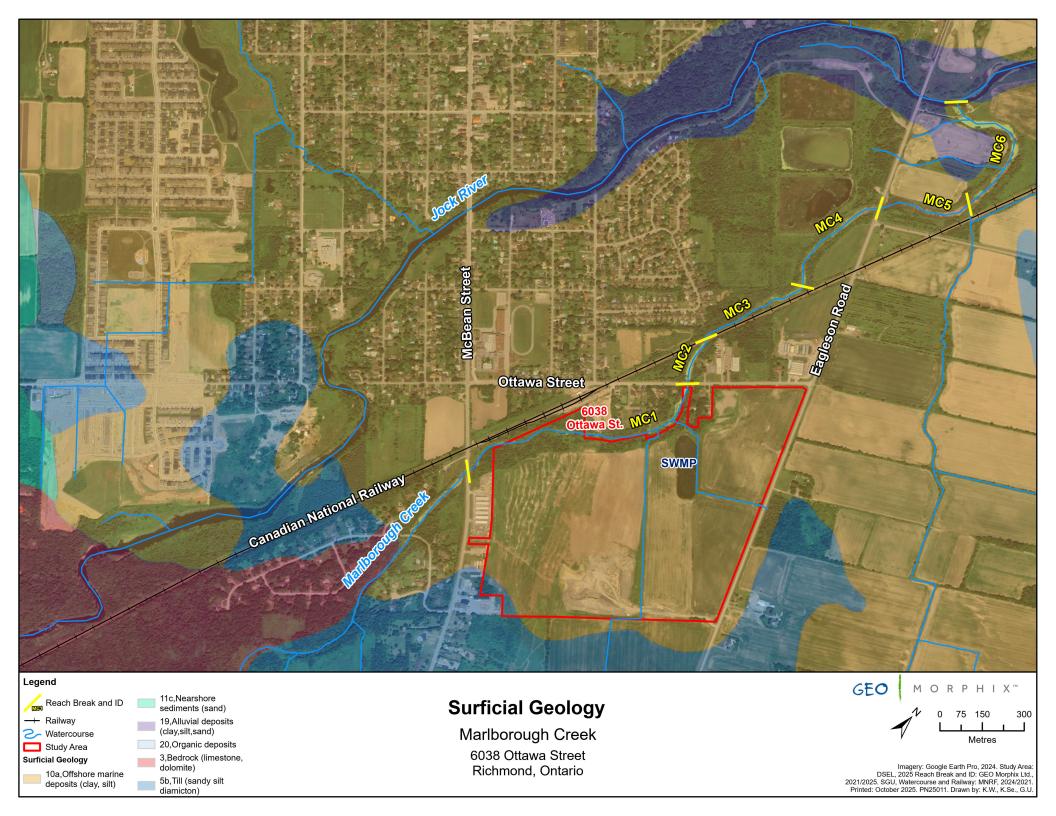
Proposed SWM Pond Study Area

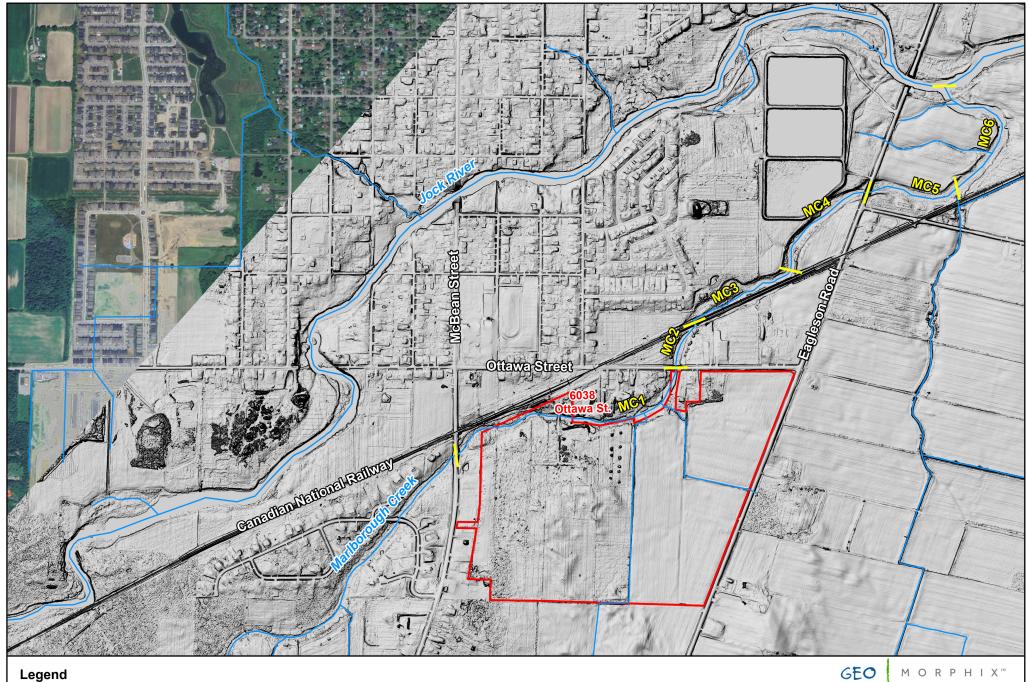
Study Area

Marlborough Creek 6038 Ottawa Street Richmond, Ontario



Imagery: Google Earth Pro, 2024, Reach Break and ID: GEO Morphix Ltd., 2021/2025. SWMP, Study Area, and Outlet: DSEL, 2021/2025. Wetland, Waterbody, Watercourse and Rallway: MNRF, 2024/2021. Printed: October 2025. PN25011. Drawn by: K.W., K.Sm., G.U.







Reach Break and ID



Railway



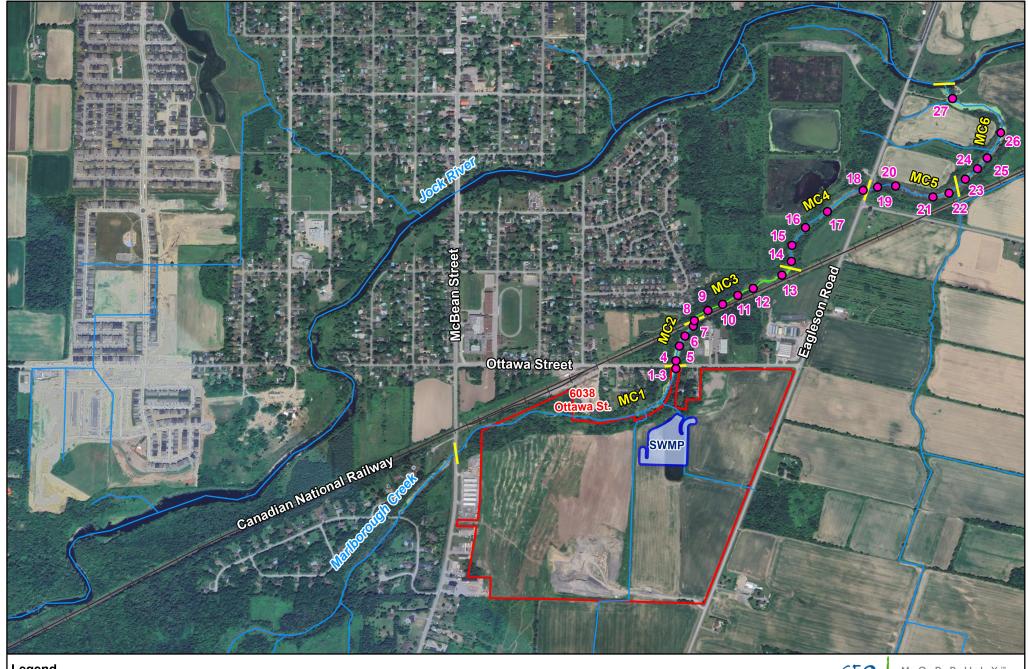
Watercourse Study Area

Study Area - Hillshade

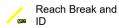
Marlborough Creek 6038 Ottawa Street Richmond, Ontario



Hillshade: MNRF, 2020. Study Area: DSEL, 2025. Reach Break and ID: GEO Morphix Ltd., 2021/2025. Watercourse and Railway: MNRF, 2024/2021.PN25011 Printed: October 2025. Drawn by: K.W., K.Sm., G.U. Appendix B: Site Photographs











Detailed Assessment





Study Area

Photo Locations

Marlborough Creek 6038 Ottawa Street Richmond, Ontario



Imagery: Google Earth Pro, 2024. Reach Break and ID, Photo Locations: GEO Morphix Ltd., 2021/ 2025. SWMP, Study Area: DSEL, 2021/ 2025. Wetland, Waterbody, Watercourse and Railway: MNRF, 2024/2021. Printed: October 2025. PN25011. Drawn by: K.W., K.Sm., G.U.

Photo 1 irlborough Cree Peach: MC1



Photograph taken facing upstream from Ottawa street box culvert of reach MC1. Note the fallen trees in the channel and dense floating rooted aquatic vegetation.





Photograph taken facing upstream from Ottawa street box culvert of reach MC1. Photo showing left bank of channel.

Photo 3 arlborough Cree



Photograph taken facing upstream from Ottawa street box culvert of reach MC1. Photo showing right bank of channel.

Photo 4
larlborough Creek



Photograph taken facing downstream from Ottawa Street box culvert of reach MC2. Channel exhibits no flow, lack of riffle-pool morphology, and dense floating rooted aquatic vegetation.

Photo 5

Marlborough Cree



Photograph taken facing downstream along reach MC2. Channel is relatively straight with industrial land use near right bank of reach.

Photo 6 arlborough Creek Beach: MC2



Photograph taken facing downstream along reach MC2. Note photo is taken at single bend in channel before entering reach MC3.

Photo 7 larlborough Cree



Photograph taken facing downstream along MC2. Note the CN railway marks the reach break between MC2 and MC3.

Photo 8 arlborough Creek



Photograph taken facing downstream under CN railway bridge marking reach break between MC2 into MC3. Note the reduction in channel width and depth from reach MC2 into MC3.

Photo 9 Irlborough Cree Reach: MC3



Photograph taken facing downstream along reach MC3. A small riffle with flowing water was observed at the upstream extent of the reach.





Photograph taken facing downstream along reach MC3. Straightened channel had few fallen trees and heavily vegetated banks with some encroachment into channel.

Photo 11 arlborough Cree Reach: MC3



Photograph taken facing downstream along reach MC3. Channel becomes less vegetated and covered near downstream end of reach. The railway embankment located along MC3's right bank was composed of cobbles, with cobbles of similar shape and size found embedded within the channel bed and bank sediments.

Photo 12 arlborough Creek Reach: MC3



Photograph taken facing downstream along reach MC3. Near the downstream end of the reach the dominant channel riparian vegetation transitions from trees and shrubs to tall grasses and herbaceous plants.

Photo 13 arlborough Creel Reach: MC3



Photograph taken facing downstream along reach MC3. The downstream end of the reach widens and enters large floodplain, channel exhibits swamp/wetland like characteristics with no flow, dense vegetation, and no defined channel.

Photo 14 Marlborough Creek Peach: MC4



Photograph taken facing downstream at reach MC4. Note CN railway along right bank. Upstream end of reach exhibits swamp/wetland like characteristics.

Photo 15

Aarlborough Cree



Photograph taken facing downstream along reach MC4. Channel is heavily vegetated by cattails and european frogbit. Stagnant water and a deep layer of unconsolidated fine sediments were present throughout the extent of the reach.

Photo 16 larlborough Creek Poach: MC/



Photograph taken facing downstream along reach MC4.

Photo 17
arlborough Cree



Photograph taken facing downstream along reach MC4. No signs of erosion or bank failures along the channel. Heavily vegetated channel and banks.

Photo 18 Iarlborough Creek



Photograph taken facing upstream of reach MC4. Photo taken from Eagleson Road which delineates reach break between MC4 and MC5.

Photo 19
arlborough Cree



Photograph taken facing upstream of reach MC5. Photo taken from Eagleson Road. Reach has the densest vegetation and widest channel of all assessed reaches.

Photo 20 larlborough Creek



Photograph taken facing upstream along reach MC5. Reach has dense instream vegetation comprised of cattails and european frogbit. Riparian vegetation is comprised of trees, shrubs, and grasses.

Photo 21 arlborough Cree



Photograph taken facing upstream along reach MC5. Open area of channel near the downstream end of reach, with no velocity and low gradient.

Photo 22 larlborough Creek



Photograph taken facing upstream of reach MC5. CN railway runs along a portion of the right channel bank. Channel is located on left side of photo.



Photograph taken facing upstream at reach MC6. Start of MC6 and end of MC5, dominant aquatic vegetation changes from cattails to duckweed resulting in more open channel.





Photograph taken facing upstream along reach MC6. Small riffle present at the beginning of reach,; one of few instances of riffle-pool morphology along the entirety of creek.

Photo 25 farlborough Cree



Photograph taken facing upstream along reach MC6. The channel is bordered by agricultural land on both banks.





Photograph taken facing upstream along reach MC6. The reach is dominated by floating rooted aquatic vegetation. No flow observed and no erosion present as reach has stable banks and low bank angles. The riparian zone at the downstream portion of the reach is bordered by an agricultural access road.

Photo 27 Iarlborough Cree



Photograph taken facing upstream at reach MC6. Confluence of Marlborough creek with Jock River, photo taken on agricultural access road which creek flows under.

Appendix C: Field Sheets

Date		2	025-07-08		Stream:		: 250				
Time	H		:25		Reach:					orough	creek
Wea	ther:		5 c overcast	713-	Location			2 - E	MC2		
Field	Staff:	K							Richn	sond, i	ON
Featu	Ires				Watersh	ned/Subv	watersh	ed:	dock	Piver	
			toring	Site	e Sketch						Compass
	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar Eroded bank/slope Undercut bank Bank stabilization Leaning tree Fence Culvert/outfall Swamp/wetland Grasses Tree Instream log/tree Woody debris Beaver dam Vegetated island YPP Standing water H1 Scarcely perceptible Smooth surface flow Upwelling Rippled Unbroken standing wav Chute Free fall H94	A Back flow	Monumented XS Monumented photo Monumented photo direction Sediment sampling Erosion pins Scour chains onal Symbols	*\\$3. \wo = 1 \wo = 1 \wo = 0 \wo = 0 \wo = 0	0.80 0.50 8.50 0.85	53 70 % 53 70 % 53 11+	2 1 - 7	B LIDICE STATE OF THE PART OF	open cane	pping con	tainer **ST = .0 **W= 13.0 **W= 13.0
	Gravel	5 <i>7</i> 58	Large boulder Bimodal		on W	SUNO	rusics !	0- W	prap/sig	wane	180=>1,
	Small cobble	S9	Bedrock/till		XEIL	1 01100	3 //00	0 B	12×_		V=0
	Large cobble	- 477				180	1	0		tea	
her					0	0 0	A		d. 501 k	1 0 1905)	NEU I
	Benchmark Backsight	EP	Erosion pin		(G)		V	aturat	V -	4	
	Downstream	RB	Rebar		45	X :	CX	\$3	wo =	0.5	
	Woody debris jam	US TR	Upstream Terrace	puces	6	4	W	culver	t-N=2	1.25	
	Valley wall contact	FC	Flood chute	concret	٠	-02	547	7	w=7	10	
	Bottom of slope	FP	Flood plain	D'				5+	+		
	Top of slope	KP		Photos	:	pauck	weld		Warrange and the same and the s		
	-,opc	NF	Knick point	Notes:	algae/1	nstran	1 469	cover	5 cnt	ire vene	h
					substro	ite de	nerali	1 51/	Ovacio	ici	
-11	ody debns c	own mor	along hanks	bas	1Ks - SI/S	52	0	1	VU		***

Page ____ of ___



Project Number: 25011 **Reach Characteristics** Watershed/Subwatershed: Date: 2025-07-08 Field Staff: KC HM dock River UTM (Upstream): Stream: Marlborough Creek Time: 8:25 **UTM (Downstream):** Reach: MC2 Weather: 25 C overcast **Channel Type Channel Zone** Flow Type Land Use Valley Type ☐ Evidence of Groundwater Location: (Table 4) (Table 5) (Table 1) (Table 2) (Table 3) **Water Quality Riparian Vegetation Aquatic & Instream Vegetation Woody Debris WD Density** Turbidity Coverage **Channel Widths** Age (yrs) Odour Type **Dominant Type** (Table 8) 13.5 WDJ/50m: (Table 16) (Table 17) (Table 6) 1 - 4 ☐ Immature (<5) ✓ In Cutbank ☑ Low □ None ☐ Mod □ Fragmented □ 4 - 10 ✓ Established (5-30) □ In Channel 2 Encroachment Reach 100 ☐ Not Present ☐ High □ Continuous □ > 10 ☐ Mature (>30) (Table 7) Coverage % organic swell **Channel Characteristics** Clay/Silt Gravel Cobble Boulder Parent Rootlets Sand **Bank Angle Bank Erosion** (Table 19) **Sinuosity Degree Sinuosity Type** 1 1 Z < 5% (Table 10) Ø 0 − 30 Bank (Table 9) П Riffle П \Box 5 - 30% □ 30 - 60 Gradient # of Channels (Table 12) П П П (Table 11) □ 60 - 90 $\Box 30 - 60\%$ Pool □ Undercut □ 60 - 100% Bed **Bank Failure Entrenchment** 1 (if no riffle-pool NIA (Table 14) (Table 13) morphology) **Bankfull Width** Down's Model **Bankfull Indicators** Wetted Width (m) 15.0 12.0 10.90 18.50 15.0 D (Table 15) (Table 18) (m) Bankfull Depth **Sed Sorting Sediment Transport** 0.50 well ☐ Yes ☑ No ☐ Not Visible 71.50 0.95 Wetted Depth (m) 71.0 71.0 Observed? (Table 20) (m)**Transport** Velocity (m/s) 0 3 % of Bed Active Undercuts (m) 0 0 0 Mode (Table 21) **Velocity Estimate** Mass Movement **Pool Depth** Geomorphic WB >1.0 WE NIA Method (m) Units (Table 22) (Table 23) Meander Amplitude Riffle-Pool % Riffles: % Pools: Riffle Length (m) 0 Spacing (m): Notes: stagnant channel with woody debos along banks, silty bed in stream reactothen + floating algal morphology, I flow/depth wonderbon Estagnant Photos:

Version #4 Last edited: 04/04/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____



Rapid Geomorphic Assessment

Project Number: 25011

Date:	9000	25-07-06	Stream:		104/101			61
ime:		25	Reach:	P	NC2	0		
Weather:		+5021910 0 °C	Location:	(Sichma	6AC		
	04 J	: HM	Watershed/Subw	ratershed:		suis		
ield Staff:	1//		And the second of the second o		10010			
Process	т	Geoi	morphological Indicato	or			sent?	Factor Value
1100000	No.	Description				Yes	No	Value
		Lobate bar				\.	1	
	2	Coarse materials in riffles	embedded				-	_
Evidence of		Siltation in pools				V	-	2/7
Aggradation		Medial bars					1	
(AI)		Accretion on point bars				-,/-	1-4-	
		Poor longitudinal sorting o				V		_
	7	Deposition in the overban	k zone			\sim	1	- 001
				Sum	of indices =	2	13	0.286
	1	Exposed bridge footing(s)					V	
Ī	2	Exposed sanitary / storm	sewer / pipeline / etc.				MIM	
	3	Elevated storm sewer out	fall(s)				NIA	
	4	Undermined gabion baske	ts / concrete aprons /	etc.			NIA	
Evidence of	5 -	Scour pools downstream of	of culverts / storm sew	er outlets			MIA	1
Degradation (DI)	6	Cut face on bar forms					1	10.
,	7	Head cutting due to knick	point migration			*	LV.	
	8	Terrace cut through older	bar material				14	
	9	Suspended armour layer	visible in bank				1	
	10	Channel worn into undistu	urbed overburden / be	drock			V	
				Sun	n of indices =	0	6	0
	1	Fallen / leaning trees / fer	nce posts / etc.					
		Occurrence of large organ				V		
	3	Exposed tree roots					1	
	4	Basal scour on inside mea	ander bends				V	
Evidence of	5	Basal scour on both sides	of channel through rif	fle			V	_ /
Widening (WI)	6	Outflanked gabion basket	s / concrete walls / etc	с.		****	NIA	_ 7
(**1)	7	Length of basal scour >50	0% through subject re	ach			NIA	
	8	Exposed length of previou	usly buried pipe / cable	e / etc.			V	
		Fracture lines along top o					V	
	10	Exposed building foundat	ion				NIA	
				Sur	n of indices =		19	0.142
	1	Formation of chute(s)					1	
	2	Single thread channel to	multiple channel				W	
Evidence of	3	Evolution of pool-riffle for		rm				
Planimetric Form	4	Cut-off channel(s)					V	9
Adjustment	5	Formation of island(s)					W	_ +
(PI)	6	Thalweg alignment out of	f phase with meander	form			V	
	7	Bar forms poorly formed					1	
		. ,	The second secon		m of indices =	0	17	0
Notes:				Stability Inde	x (SI) = (AI	+DI+W	I+PI)/4	4 = 0.107
Notes:				In Regime	In Transi			n Adjustment
				Ø 0.00 - 0.2		21 - 0.4		□ 0.41
				P 0.00 - 0.2				

Project Number: 2501 Rapid Stream Assessment Technique

Date:	2025-07-08	Stream:	Wallpolon	ar check
Time:	8:25	Reach:	MC2	
Weather:	25°C overcas	Location:	Richmond	(12 N. M.)
Field Staff:	KC HW	Watershed/Subwater	shed: Jock M	166
Category	Poor	Fair	Good	Excellent
*2000 Lub (200 (2	stable	 50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common 	 71-80% of bank network stable Infrequent signs of bank sloughing, slumping or failure 	> 80% of bank network stable No evidence of bank sloughing, slumping or failure
Channel	Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m	 Stream bend areas unstable Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m 	 Stream bend areas stable Outer bank height 0.6-0.9 m above stream bank (1.2-1.5 m above stream bank for large mainstem areas) Bank overhang 0.6-0.8 m 	Stream bend areas very stable Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstern areas) Bank overhang < 0.6 m
Stability - no exposed	Young exposed tree roots abundant > 6 recent large tree falls per stream mile	Young exposed tree roots common 4-5 recent large tree falls per stream mile	Exposed tree roots predominantly old and large, smaller young roots scarce 2-3 recent large tree falls per stream mile	Exposed tree roots old, large and woody Generally 0-1 recent large tree falls per stream mile
	Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised	Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	Channel cross-section is generally trapezoidally- shaped	Channel cross-section is generally trapezoidally-shaped	Channel cross-section is generally V- or U-shaped	Channel cross-section is generally V- or U-shaped
Point range	□ 0 □ 1 □ 2	□ 3 □ 4 □ 5	減 6 □ 7 □ 8	□ 9 □ 10 □ 11
Netfal -no	> 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60- 85% embedded for large mainstem areas)	25-49% embedded (35- 59% embedded for large mainstem areas)	Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
	Few, if any, deep pools Pool substrate composition >81% sand- silt	Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt	Moderate number of deep pools Pool substrate composition 30-59% sand-silt	High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) Pool substrate composition <30% sand-silt
Channel Scouring/ _ Sediment	Streambed streak marks and/or "banana"-shaped sediment deposits common	Streambed streak marks and/or "banana"-shaped sediment deposits common	Streambed streak marks and/or "banana"-shaped sediment deposits uncommon	Streambed streak marks and/or "banana" shaped sediment deposits absent
Deposition	Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area	Fresh, large sand deposits common in channel Small localized areas of fresh sand deposits along top of low banks	Fresh, large sand deposits uncommon in channel Small localized areas of fresh sand deposits along top of low banks	Fresh, large sand deposits rare or absent from channel No evidence of fresh sediment deposition on overbank
- no pos.	Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	Point bars common, moderate to large and unstable with high amount of fresh sand	Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand	stable, well-vegetated and/or armoured with little or no fresh sand
Point range	□ 0 □ 1 □ 2	□ 3 □ 4	⋈ 5 🗆 6	□ 7 □ 8

Version #2 Last edited: 10/02/2023

Senior staff sign-off (if required): _____ Checked by: ___



M O D D H I V "

Category	P	PN: 25011	Location:	Jorlporonar Cla
Category	Poor	Fair	Good	Excellent
	 Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas) 	Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	Wetted perimeter > 85% bottom channel width (> 90% for large mainstem areas)
-ho viftes	type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	and runs dominant	Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow	Riffles, runs and pool habitat present Diverse velocity and dept of flow present (i.e., slow fast, shallow and deep water)
Physical Instream	 Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble 	Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble	Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble	Riffle substrate composition: cobble, gravel, rubble, boulder mi with little sand > 50% cobble
Habitat	Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm for large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	Riffle depth > 20 cm for large mainstem areas
	Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) wit good overhead cover/structure
	Extensive channel alteration and/or point bar formation/enlargement	 Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement 	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	No channel alteration or significant point bar formation/enlargement
	Riffle/Pool ratio 0.49:1 ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	Summer afternoon water temperature > 27°C	• Summer afternoon water temperature 24-27°C	 Summer afternoon water temperature 20-24°C 	 Summer afternoon water temperature < 20°C
Point range	□ 0 頁 1 ፱ 2	□ 3 □ 4	□ 5 □ 6	□ 7 □ 8
	Substrate fouling level: High (> 50%)	 Substrate fouling level: Moderate (21-50%) 	Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)
ater Quality	Brown colour TDS: > 150 mg/L	Grey colourTDS: 101-150 mg/L	Slightly grey colour TDS: 50-100 mg/L	Clear flowTDS: < 50 mg/L
Q ,	Objects visible to depth < 0.15m below surface	Objects visible to depth 0.15-0.5m below surface	Objects visible to depth 0.5-1.0m below surface	Objects visible to depth 1.0m below surface
	Moderate to strong organic odour	Slight to moderate organic odour	Slight organic odour	No odour
Point range	□ 0 □ 1 □ 2	□ 3 □ 4	5 □ 6	7 8
Riparian Habitat	Narrow riparian area of mostly non-woody vegetation	Riparian area predominantly wooded but with major localized gaps	Forested buffer generally 31 m wide along major portion of both banks	Wide (> 60 m) mature forested buffer along both banks
Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	 Canopy coverage: 50- 60% shading (30-44% for large mainstem areas) 	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	• Canopy coverage: >80% shading (> 60% for large mainstem areas)
oint range	001	2 □ 3	□ 4 □ 5	0607
tal overall se	core (0-42) = 20	Poor (<13) Fa	iir (13-24) Good (25-3	4) Excellent (>35)

Version #2 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____



General Site Characteristics

Project Number: 25011

N-1		25011	
Date:	2025-07-08	Stream:	Marlborough creek
Time:	9:00	Reach:	MC3
Weather:	25°C overcast	Location:	Richmond ON
Field Staff:	KC HM	Watershed/Subwatershed:	dock River

	250 OVEY COST	Location:	Richmond ON
Field Staff:	KC HM	Watershed/Subwatershed:	Jock River
Features	Monitoring	Site Sketch	Compass
Reach break	-≎≎- Long-profile		
Station location	I Monumented XS		2 2 2 6 6
Cross-section	Monumented photo		17 443 1
Flow direction	Monumented photo	×53	5 83(4.)
	▼ direction	WW= 1.03	6.9 m xsb. 15 - xs3
Pool	Sediment sampling	wh = 002 (1000
Sediment bar	Erosion pins	C BD = 6.08	3 3 3-14
###### Eroded bank/slope	Scour chains	V=0.155WY9	51
Undercut bank	Additional Symbols	Bed = S1-S4	1297
XXXXX Bank stabilization	Questid inste	not embedded	45>
Heaning tree	Everyosed voots	EMAGNOSO	6
Culvert/outfall			3152 3
Swamp/wetland/a	igae		
'∀'∀ Grasses	7		23 -51-54
Tree			x52
Instream log/tree		xS2	3 2 57
* * Woody debris		WW = 3,42	EU 1/2-57
Beaver dam		WD = 0.09	8 19
Vegetated island		18W = 6.42	
ow Type	1	90 = 0. 70	the Charles of the
11 Standing water H:	1A Back water	N = 0	the age
H2 Scarcely perceptible		Bed = S1-S3	51_55 (0) 7 -
H3 Smooth surface flow	4	siltation	47 60-10.11
H4 Upwelling	•		3 0 6 35
H5 Rippled			
H6 Unbroken standing	Wave		Station W hydray bon
H7 Broken standing wa	1		3 The sween
H8 Chute	VC		- V V
	A Dissipates below free fall		18 51 51 AC D
ıbstrate	Dissipates below free fall		\$ 51 51 40th 2 3
51 Silt	S6 Small boulder		55 51-55 anic 50
52 Sand	S7 Large boulder	va)	00 -00 / 5
63 Gravel	S8 Bimodal	XS1 WW=1.102	0.0,// 2 /2
54 Small cobble	S9 Bedrock/till	WO= 0.00	(3) Note of 12
55 Large cobble	33 Bedrocky till	8W=4.07	00):13:00
her		80 = 0.45	SO 01/1/3/4 3
Mer Benchmark	EP Erosion pin	V = 0 Banks = S1	1 X
Backsight	RB Rebar	Bed = S1-S4	3 1.78
Downstream		organics	83 81-54
DJ Woody debris jam			\$ 0000 (10,10)
VC Valley wall contact	2007.04000000000000000000000000000000000		organics sapring
	FC Flood chute		
S Bottom of slope	FP Flood plain	Photos:	
S Top of slope	KP Knick point	Notes: minimal bank ens	100 siltation observed
	umite		3
		weld + vooted emergent veget	

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Page ____ of _____



Gen	eral Site Cha	racte	ristics	Proj	ect Numl	ber: 25011			MORPHIX
Date:		202	5-07-08		Stream:		Mari	perosod	r creek
Time:	Taxaliyası.	9:3			Reach:		MC3	.50	1/ 0.0010
Weatl	her:		i overcast		Location:		011	mond	***************************************
Field:	Staff:	KC	HM			Subwatershed:	Jock		
Featur	rec						1000		
Feature R × × × × × × × × × × × × × × × × × ×	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar Eroded bank/slope Undercut bank Bank stabilization Leaning tree Fence		Long-profile Monumented XS Monumented photo Monumented photo direction Sediment sampling Erosion pins Scour chains nal Symbols		Sketch				Compass
	Culvert/outfall Swamp/wetland Grasses Tree Instream log/tree Woody debris Beaver dam Vegetated island Type Standing water H1A	r Back v	vater	3		D=0.64 V	177	vated once	54
H2 H3 H4 H5 H6 H7 H8 H9		ave	ates below free fall		wigh -	55 V	arde nicons		
Substr S1 S2 S3 S4 S5 Other BM BS DS WDJ	Silt Sand Gravel Small cobble Large cobble Benchmark Backsight Downstream Woody debris jam	S6 S7 S8 S9 EP RB US TR	Small boulder Large boulder Bimodal Bedrock/till Erosion pin Rebar Upstream Terrace			3 ss -0 00 s1 - s1 s1 - s1 s1 - s1	2 cheen sp~0	waney ma!	
VWC BOS	Valley wall contact Bottom of slope	FC FP	Flood chute Flood plain	Dhot-		0 /7 SI W	/ - (
TOS	Top of slope	KP	Knick point	Photo			with the		Al Al
	-		- Justine	.1000				12	

Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____ K.C.

Page 2___ of _2_



Reach Charac	teris		roject N	umber:	Process de la successión de la constante de la						100.00	- 		Variable Southern				
Date:		2025-0	80-4		Field	Staff:	KC HA	1			Wa	tershe	d/Subv	vatershed	1: 90	CK RI	ver	
Time:		9:34			Strea	m:	Narboro	ugh) Cro	ek	UT	M (Ups	tream)	:				
Weather:		25°C OV	creast		Reac	1:	MCS				UT	M (Dov	vnstrea					
Land Use		alley Type	2 1	hannel	Туре	and a second	Channel Zone Table 4)	2		ow Type		ZE	vidence (of Groundw		vater of ocation:		hoto:
(Table 1)		able 2)		Table 3)						able 5)						lib-r		
Riparian Veget	ation						Aquatic 8	& Ins						We	iter Qu	-		
Dominant Type (Table 6)	1/3	Coverage □ None	Channel	4	Age (yrs) Immatu	re (<5)	(Table 8)		,5 _P	oody Debris In Cutbank	.□ Lo		WDJ/50n	n:	Odd (Table			arbidity able 17)
Encroachment (Table 7)	١	☐ Fragment ☐ Continuou			Mature	ned (5-30) (>30)	Reach Coverage %			In Channel Not Presen			2					
Channel Chara	cterist	ics	1. V.															
Sinuosity Type (Table 9)		Sinuos	ity Degree (Table 10)		Bank	Angle	Bank Erosion	1	((Table 19) Bank		/Silt	Sand	Gravel (Cobble	Boulder	r Parent	Rootlets
Gradient		# 0	f Channels		□ 30	- 60	□ 5 - 30%			Riffle	Į	3		4				
(Table 11)	-	, , ,	(Table 12)		□ 60	- 90	□ 30 - 60%			Pool	Æ	3	1	2				
Entrenchment (Table 13)		Ва	nk Failure (Table 14)		□ Un	dercut	□ 60 - 100%		(it	Bed f no riffle-pool morphology)	,[
Down's Model A (Table 15)	D	Bankfull 1	Indicators (Table 18)	3,5			Bankfull Wi (dth (m)	+.07	6.4	2	6.08	Wett	ed Width (m) (4	62	3.42	1.03
Sed Sorting (Table 20)	mod	Sediment	Transport Observed?	☐ Yes	□ No Ø	, Not Visible	Bankfull De (pth (m)	0.45	671)	0.70	Wett	ed Depth (m) 0.	00	0.09	003
Transport Mode (Table 21)	1,2,3	% of	Bed Active				Undercuts ((m)	0	0		0	v	elocity (m	/s) (0	0	0.155
Geomorphic Units (Table 22)	7,9	7	Movement (Table 23)				Pool De	pth (m)	0.11	0.21	0		Vei	locity Estim Meti		NB	WB	mg
Riffle-Pool Spacing (m):			% Riffles:	5	% Poo	ls: 5.	Riffle Length ((m)	6.9				Meand	der Ampliti (nde m)			
Notes:		_																
generally	lov	u, stabl	e bank	S, 2 i	nstanc	es of	exposed ma	iture	tre	e worth				some	dre	al		
Lo channel	bed	MOVPhe	stoqu 1	nman	y m	ns with	minimal	to	NO f	10W,	2 N		with					
LO npanan	veg	etochan -	fatite				ank, open					nght	- bet	ore ra	lway	tracks	[-	
	<4 U	channel	waths	between	en ch	onul o	nd railway			channel		a rhs	OD (eft boi	114			
LD substral	rca	country f	romani	y dul	not a	en carr	ed in nff	105.	but	silten	00 1	was v	noted	in John	a.v	ras		
LI SULDITUI	- /(W. C.	K #04 E 7 1		135/1		373 -315			2.7.1.4.16. 5								2
								Mentero-to-										
Photos:		4							www									
e e	***************************************																	

Version #4 Last edited: 04/04/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____C



Project Number: 25011 **Rapid Geomorphic Assessment**

ate:	2025	80-70-2	Stream:		Marboro	ugh Cre-	ek	
ime:	9:3		Reach:		MC3			
Weather:	250		Location:	70	Richmon	nd, on		
Field Staff:	KC	HM	Watershed/Subv	watershed:	KC H			
	1	111.1					sent?	Factor
Process		T	Geomorphological Indicate	or		Yes	No	Factor Value
	No.	Description				res	INO	
	1	Lobate bar	M			2.1		_
	2		ffles embedded - 2 wift	LES, WEITHER	EMPCOO.	60		
Evidence of Aggradation	3	Siltation in pools Medial bars					- Acceptance	2/7
(AI)	5		rc ala un annon a successiva					-
, ,	6	Poor longitudinal sort	rs - plo Uncommon					-
	7	Deposition in the ove						
		Deposition in the ove	IDAIR ZOIIC		Sum of indice	s =		0.286
	Т.				- Transc			
	1	Exposed bridge footin		1	-110		1110	
	2		orm sewer / pipeline / etc.				NIA	_
	3	Elevated storm sewer	paskets / concrete aprons /	, etc			NIA	
Evidence of	5		eam of culverts / storm sev		<u> </u>		NIA	0.
Degradation	6	Cut face on bar forms		ver outlets			17	- 5
(DI)	7	Head cutting due to k						
	8	Terrace cut through of						-
	9	Suspended armour la						
	10		disturbed overburden / be	drock				
	1 10	Chamilla worm into an			Sum of indice	es =		0
	1	Fallen / leaning trees	/ fence nosts / etc.	<u>,,,</u>		-		
	2	Occurrence of large of				-		
	3		2 instances of	withing the	e ants			,
	4	Basal scour on inside		TOTAL THE	, — (00-10)			
Evidence of	5		sides of channel through ri	ffle				
Widening (WI)	6		skets / concrete walls / et				NIA	2/8
(441)	7		r >50% through subject re					
	8		eviously buried pipe / cabl					
	9	Fracture lines along t						
	10	Exposed building fou	ndation				WIA	
, , , , , , , , , , , , , , , , , , , 					Sum of indice	es =		0.25
	1	Formation of chute(s)				-	
	2	Single thread channe						
Evidence of Planimetric	3		e form to low bed relief for	rm				0.5
Form	4	Cut-off channel(s)	A CONTRACTOR OF THE CONTRACTOR					
Adjustment	5	Formation of island(s	5)					
(PI)	6	Thalweg alignment o	ut of phase with meander	form				
	7	Bar forms poorly form	med / reworked / removed				OF THE PERSON NAMED IN COLUMN TO PERSON NAME	
	***************************************				Sum of indice	es =		0
Notes:				Stability Ir	ndex (SI) =	(AI+DI+W	I+PI)/4	4=0,134
				In Regin	ne In Tra	ansition/St	ress I	n Adjustmen
				X 0.00 - 0		0.21 - 0.4		□ 0.41

Version #3 Last edited: 10/02/2023

Rapid Stream Assessment Technique Project Number: 25011

Pate:	2025-07-08	Stream:		Harbonugh	creck		
ime:	9:34	Reach:		MC3			
Veather:	25°C overcout	Location:		Richmond, ON	1 112016 1		
ield Staff:	KC HM	Watershed/Subwater	dock River				
Category	Poor	Fair		Good		Excellent	
ion, ion, ion	stable	 50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common 	stable • Infreque	of bank network ent signs of bank ng, slumping or	stable • No evide	of bank network ence of bank g, slumping or	
Channel	 Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 	 Stream bend areas unstable Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m 	Outer b m abov 1.5 m a for large	bend areas stable ank height 0.6-0.9 e stream bank (1.2- bove stream bank e mainstem areas) verhang 0.6-0.8 m	stable Height < stream (stream (mainste	c 0.6 m above (< 1.2 m above pank for large m areas) erhang < 0.6 m	
Channel Stability • Young exposed tree abundant • > 6 recent large tree per stream mile		 Young exposed tree roots common 4-5 recent large tree falls per stream mile 	predom large, s scarce • 2-3 rec	d tree roots inantly old and maller young roots ent large tree falls eam mile	large an General	tree roots old, d woody y 0-1 recent large s per stream mile	
e decidente de la constante de	Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised	 Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised 	general	1/3 of bank is ly highly resistant bil matrix or material	general	1/3 of bank is y highly resistant il matrix or materia	
	Channel cross-section is generally trapezoidally- shaped	Channel cross-section is generally trapezoidally-shaped		l cross-section is ly V- or U-shaped		cross-section is y V- or U-shaped	
Point range	□ 0 □ 1 □ 2	□ 3 □ 4 □ 5	Ø e		□ 9	□ 10 □ 11	
	 > 75% embedded (> 85% embedded for large mainstem areas) 	 50-75% embedded (60- 85% embedded for large mainstem areas) 	25-49% embedded (35- 59% embedded for large mainstem areas)		25% sa embedo	nbeddedness < nd-silt (< 35% ed for large m areas)	
dana mgh	Few, if any, deep pools Pool substrate composition >81% sand- silt	Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt	pools • Pool su	te number of deep bstrate composition 6 sand-silt	(> 61 c (> 122 mainste • Pool sul	mber of deep pools m deep) cm deep for large m areas) ostrate composition and-silt	
Channel Scouring/ — Sediment	Streambed streak marks and/or "banana"-shaped sediment deposits common	Streambed streak marks and/or "banana"-shaped sediment deposits common	and/or	bed streak marks "banana"-shaped nt deposits	and/or	ped streak marks banana" shaped nt deposits absent	
Deposition	Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area	 Fresh, large sand deposits common in channel Small localized areas of fresh sand deposits along top of low banks 	Fresh, large sand deposits uncommon in channel Small localized areas of fresh sand deposits along		rare or • No evid	arge sand deposits absent from chann ence of fresh nt deposition on ık	
pbs uncommon	Point bars present at most stream bends.	Point bars common, moderate to large and unstable with high amount of fresh sand	well-ve	ars small and stable, getated and/or red with little or no and	stable, and/or	ers few, small and well-vegetated armoured with little esh sand	
Point range	□ 0 □ 1 □ 2	□ 3 □ 4		2 5 □ 6	1	7 🗆 8	



Date: 202	5-07-08	PN: 25011	Location:	2ichmond, on
Category	Poor	Fair	Good	Excellent
	Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)
	Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	and runs dominant.	 Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow 	 Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
Physical Instream Habitat	Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble	Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble	Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble	Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble
Habitat	Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm for large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	 Riffle depth > 20 cm for large mainstem areas
	Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	Extensive channel alteration and/or point bar formation/enlargement	Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1; ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
-	• Summer afternoon water temperature > 27°C	Summer afternoon water temperature 24-27°C	Summer afternoon water temperature 20-24°C	Summer afternoon water temperature < 20°C
Point range	O O O 1 O 2	23 □ 4	□ 5 □ 6	□ 7 □ 8
	• Substrate fouling level: High (> 50%)	Substrate fouling level: Moderate (21-50%)	Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)
Water Quality	Brown colourTDS: > 150 mg/L	Grey colourTDS: 101-150 mg/L	Slightly grey colour TDS: 50-100 mg/L	Clear flow TDS: < 50 mg/L
water Quanty	Objects visible to depth < 0.15m below surface	Objects visible to depth 0.15-0.5m below surface	Objects visible to depth 0.5-1.0m below surface	Objects visible to depth 1.0m below surface
	 Moderate to strong organic odour 	 Slight to moderate organic odour 	Slight organic odour	No odour
Point range	00102	3 0 4	□ 5 월 6	□ 7 □ 8
- v la namw woody Riparian Habitat	Narrow riparian area of mostly non-woody vegetation	Riparian area predominantly wooded but with major localized gaps	Forested buffer generally 31 m wide along major portion of both banks	Wide (> 60 m) mature forested buffer along both banks
Conditions CN Rall	Canopy coverage: <50% shading (30% for large mainstem areas)	 Canopy coverage: 50- 60% shading (30-44% for large mainstem areas) 	• Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	• Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	O O 1	፮ 2 □ 3	□ 4 □ 5	0607
Total overall so	core (0-42) = 22	Poor (<13)	air (13-24) Good (25-3	Excellent (>35)
Version #2 Last edited: 10	Senio 1/02/2023	r staff sign-off (if required):	Checked by:	Completed by:

Page 2 of 2



illei a i	Site Chara	2025	80-40-6	Stream:			ondr cusek
te:				Reach:		MC4	
ne:		9:54	205626	Location:		Richmon	
eather:		27	c overcas.		Subwatershed:	100K [1941
eld Staff:		KC	HW				Compass
		onitoring		Site Sketch		1	
atures	ch break	-o-o- Long	-profile	X63		1	13/6
	ion location	Mon	umented XS	WW = 9.5 WD = 0.31		1/(1)	13/(1/
	s-section	Mon	umented photo	BIN = 16.5		\$ 7 13	
	direction		umented photo	BD = 0.75.		153 41, 2	151/HI
~→ Riffle	e		ction	V = O		SO THE	182
O Pool	1	1000	iment sampling	Ded = 51	Con Ser	N KTOS	
Comme	Illicite Da.	Eros		900 - 1	Series of	E A A	-51 7453
	ded bank/slope	the same of the sa	ur chains			1/8/1/	(h)
	lercut bank	Additiona	Syllibols			(V) (V)	<u>-</u> 51-55
	nk stabilization				8205 / 56	1894	anodian pord
1111	ning tree					1/1/1/50	dminrow 23
					4	H OF T MUD	23
~ C	vert/outfall amp/wetland			XS2	50	11 / 1 sp 7	200
	asses			0.20 = WD	a (W 1 1 10	3000
₩₩W Gra ∰ Tre				0.46=50		13 P 13	340
	stream log/tree	S. S. Salandard Co.		ww = 11.5	L		5
Market 1	oody debris			BW= 16.0	L	V 3/\	1 to 100
	eaver dam			V = 0	3	10118	
7.	egetated island			loed = 51		1 1 2 2	
Flow Type	8			3cn-31		W. W. Hoo	×52
	anding water Hi		ater		68 /	Ma in loss	3 3
	carcely perceptible					46	VE .
	mooth surface flow	N			K5:	20.	8 B
	pwelling				8	公文》	
	ippled	wave		X51		3	18/1.
	nbroken standing roken standing w			WW=0.29			0=0.29
	Chute			W=11.5.		3 XSI-	1 1 1
		9A Dissipa	ates below free fall	8W = 18.5		3 1 / / 1	COW
Substrat	k and a second			8D=1.05	denje	(+ f 2 / 1	V Of Supras
	Silt	S6	Small boulder	V = 0	pat	ch / W, V	- 1911 rolle
	Sand	S7	Large boulder	Bed = 51 Bank = 51		3 . V	1.10 May 19
S3 (Gravel	S8	Bimodal	50.11		/4	(I) cala
S4 S	Small cobble	S9	Bedrock/till				sign
S5 1	arge cobble				&		\\ \\
Other			Erosion pin			· \	48/
	Benchmark	EP	Rebar			V	8
	Backsight	RB	Upstream				
	Downstream		Terrace				
100	Woody debris jan	ā	Flood chute				
	Valley wall contact	T FP	Flood plain	Photos:			
	Bottom of slope	KP	Knick point	Notes: Swa	mp/metland 1	siltation	
TOS	Top of slope		The state of the s				
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	noted em	ergicht	mg + algae	a stream bank			

Version #4 Last edited: 21/02/2023

Senior staff sign-off (if required): _

_ Checked by: _



General Site Characteristics

Date:		20	30-F0-Z6C	3	Stream	•	. & 5 6		Clhare	nar cheek
Time:		10:			Reach:			MC		3,
Weat	her:		to overca	57.1	Locatio	n:		12.000 (1.000 (ask))	hmon	Ŋ
Field	Staff:	K	HM	101			watershed	THE RESERVE AND ADDRESS OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLU	CK	1761
Featu	res	Monito					vatersneu	100	I CN	106.
	Reach break		Long-profile	Sit	e Sketch					Compass
り	Station location	1	Monumented XS							
xx	Cross-section	_	Monumented photo							(12)
	Flow direction		Monumented photo							
~~	Riffle	₩	direction							
	Pool		Sediment sampling							
CONTROL OF THE PARTY OF THE PAR	Sediment bar	шш	Erosion pins							
111111111111111111111111111111111111111	Eroded bank/slope	8	Scour chains							
	Undercut bank	Additio	onal Symbols							
XXXXXX	Bank stabilization									
	Leaning tree								100	
XX	Fence									
	Culvert/outfall									
	Swamp/wetland									
WWW	Grasses		-,							
	Tree									
	Instream log/tree								1	
* * *	Woody debris									
W V	Beaver dam									
Flow T	Vegetated island									
H1	Standing water H1	A Back	water							
H2	Scarcely perceptible		water							
НЗ	Smooth surface flow	HOW								
Н4	Upwelling									
Н5	Rippled		**							
Н6	Unbroken standing w	ave								
H7	Broken standing wav		gr -2"							
H8	Chute									
Н9	Free fall H9A	A Dissip	ates below free fall							
Substr						0				
S1	Silt	S6	Small boulder			73)	100/03/		
S2	Sand	S7	Large boulder			200	N.	>- HEC	tangular	
S3	Gravel	S8	Bimodal			1330	3/		culvert	
S4	Small cobble	S9	Bedrock/till				XW: Y	/ 0 \		
S5 Other	Large cobble					3/	J. X.	18 hu	vader a	
BM	Benchmark	ED	Erosion -:-		్ర	1	7. M	ropen.	werd of	daye
BS	Backsight -	EP RB	Erosion pin			- 4	1	12 low o	18055	V**
DS	Downstream	US	Rebar			+	(:::X	P	algal +	
WDJ	Woody debris jam	TR	Upstream Terrace			3	kind-			
	Valley wall contact	FC	Flood chute			1-1-1	(1)	&		
BOS	Bottom of slope	FP	Flood plain	DL-1			IVVI			
TOS	•			Photo						
.03	Top of slope	KP	Knick point	Notes	mats	of lil	y pad to	ype we	petation	in open or
-						-			/	
						1				
Versio			Senior staff sign-o	off (if rea	uired):	C	hecked hv		Complete	by: Ke
Last ed	dited: 21/02/2023		2.3	(-/-				Jompiece	d by: <u>Fe</u> e <u>2</u> of <u>2</u>
									Pag	e <u></u> of <u></u>



Reach Chara	etorici	tice D	roject Ni	ımharı	25	011													MORPHIX
Date:	Cteris	2025-			Field :	COLUMN TO SERVICE STATE OF THE	1	(C FIR	~			Waters	hed/S	ubwate	rshed:	Jo	CY	river	
Time:		9:54			Stream	300000000		arlbo	roval	C re	CK	UTM (U	pstrea	m):					
Weather:			Overca	54	Reach	1:	N					UTM (E	ownst	ream):					
Land Use	/ Va	alley Type		hannel			hann	nel Zone Flow Type groundwater of Evidence of Groundwater Local						sheen	hosteva	Photo			
(Table 1)		able 2)	_	Table 3)	.,,,,	d (1	Table ·	4)	2	(Tabl		2	# Evider	ice or Gr	ounawai	er Loc	ation	- 0	FIIOLO
Riparian Vege	tation							Aquatic 8	k Instr	eam V	egetatio	on			Wat	er Qu	ality		
Dominant Type (Table 6)		Coverage □ None	Channel \ 1 -	4 [Age (yrs) Immatur			Type (Table 8)]⊠ In	y Debris Cutbank Channel	WD Densi	-	/50m:		Odou (Table	16)	(Turbidity Table 17)
Encroachment (Table 7)	2	Continuous		/	Mature (Reach Coverage %	95		t Present					[p	_ orga	inic	
Channel Chara	acterist	tics					4												
Sinuosity Type (Table 9)		Sinuosi	ty Degree (Table 10)	1	Bank 0 -	Angle 30		nk Erosion < 5%	1	(Та	ble 19) Bank	Clay/Silt	: San			bble	Boulder		
Gradient (Table 11)	1	# of	Channels (Table 12)	1	□ 30 □ 60		/ .	5 - 30% 30 - 60%			Riffle Pool	N N							
Entrenchment (Table 13)	2	Ва	nk Failure (Table 14)	1	□ Und	dercut		60 - 100%		(if no mo	Bed riffle-pool prphology)	N]	X		×		
Down's Model (Table 15)	D	Bankfull I	indicators (Table 18)	3			В	ankfull Wi (dth (m)	1.5	16	16.	,5 v	Vetted V	Vidth (m) []	.5	11,5	9,5
Sed Sorting (Table 20)	501	Sediment C	Transport Observed?	☐ Yes	⊠ No □	Not Visible	В	ankfull De (pth (m)	05	0.85	0,3	75 v	Vetted D	epth (m	0.0	29	0.20	0.31
Transport Mode (Table 21)	3	% of E	Bed Active				U	Indercuts ((m))	0			Veloc	ity (m/s	s) [0	0
Geomorphic Units (Table 22)	9	Mass I	Movement (Table 23)	1 1		E		Pool De	pth (m)						y Estima Metho	od			
Riffle-Pool Spacing (m):		i i	% Riffles:	5	% Pool	s: 95	Riff	le Length ((m)				M	eander A	Amplitud (n				
Notes:							1 1 1		-1 3	A. C. a	7.105	· 1		nin.	u /	(201	LOV	< c.0	arian
Char		\	mairi		41010		-909	tated	1/1	7+0	196L	N/4 6	1000		\$100			mina	
CONGLOR		10 Cha	11 30	19 W	16001	16941		10110	7 11	01	XCGGU		1010		VC++7		46b-		
with ?	10 1	relocit	110	Gilie	(,)	001		J	1 1						-4.× 4.4				
					· · · · · · · · · · · · · · · · · · ·												,		
														A. C.					
Photos:						odladaja (** ** ** ** ** ** ** ** ** ** ** ** **				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,									
Version #4									Senior s	staff sid	gn-off (if	required):	Cł	necked t	oy:		Complete	d by: HM

Version #4 Last edited: 04/04/2023



Rapid Geomorphic Assessment

Project Number: 25011

pools n point bars udinal sorting of bed materials in the overbank zone ridge footing(s)	vatershed: Jo	CK river	resent?	Factor Value
Geomorphological Indicator terials in riffles embedded – No N-P pools in point bars udinal sorting of bed materials in the overbank zone	vatershed: Jo	P Yes	resent?	
Geomorphological Indicator terials in riffles embedded – No N-P pools in point bars udinal sorting of bed materials in the overbank zone	vatershed: Jo	P Yes	resent?	
Geomorphological Indicator terials in riffles embedded – no nepools on point bars udinal sorting of bed materials in the overbank zone	fles	P Yes	resent?	
terials in riffles embedded – No nepools In point bars In point bars In the overbank zone In the footing(s)	fles.	Yes		
terials in riffles embedded – no ne pools on point bars udinal sorting of bed materials in the overbank zone		J	Wo	- 01
pools n point bars udinal sorting of bed materials in the overbank zone ridge footing(s)				
pools n point bars udinal sorting of bed materials in the overbank zone ridge footing(s)			V	- 21
on point bars udinal sorting of bed materials in the overbank zone ridge footing(s)			V	21
n point bars udinal sorting of bed materials in the overbank zone ridge footing(s)			- 1	1 1 1
in the overbank zone				- 0/7.
in the overbank zone idge footing(s)		1 1/		-
idge footing(s)			- /	_
	Cuma of	indicas —	- Y	0.286
	Sum or	indices =		0.000
			- N//	_
nitary / storm sewer / pipeline / etc.			NA	_
corm sewer outfall(s)			NY A	- 0
d gabion baskets / concrete aprons /			N/A	- 6
s downstream of culverts / storm sew	ver outlets		1	
n bar forms				_
ng due to knickpoint migration			1	_
t through older bar material			1	_
l armour layer visible in bank			IVA.	_
orn into undisturbed overburden / be			<u> </u>	0
	Sum or	indices =	_	+~~
aning trees / fence posts / etc.		V.		
e of large organic debris	V			
ee roots - uncommon				
			11/	- 01
			NIA	1/8
			IVIA	
			1/	
	e / etc.		1 1	_
uilding foundation		5 in diag.	114/7	025
	Sum of	indices =		0.23
The second secon				
				_
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			1	1 7
			$-+V_{-}$	
poorly formed / reworked / removed		f i di a a	-	٥.
			1	
	In Regime	Im Tunnaition /	ATT 8	
		In Transition/		n Adjustment
	Ø 0.00 - 0.20	□ 0.21 - 0		n Adjustmen □ 0.41
	d gabion baskets / concrete walls / et basal scour >50% through subject reength of previously buried pipe / cablenes along top of bank building foundation of chute(s) ead channel to multiple channel of pool-riffle form to low bed relief formnel(s) of island(s) slignment out of phase with meander	e of large organic debris ree roots ~ \(\text{NLOMMOR} \) Ir on inside meander bends Ir on both sides of channel through riffle d gabion baskets / concrete walls / etc. basal scour >50% through subject reach ength of previously buried pipe / cable / etc. ines along top of bank building foundation Sum of of chute(s) ead channel to multiple channel of pool-riffle form to low bed relief form fannel(s) of island(s) elignment out of phase with meander form spoorly formed / reworked / removed Sum of Stability Index (e of large organic debris ree roots ~ Uncommon Ir on inside meander bends Ir on both sides of channel through riffle Id gabion baskets / concrete walls / etc. basal scour >50% through subject reach ength of previously buried pipe / cable / etc. ines along top of bank building foundation Sum of indices = If of chute(s) ead channel to multiple channel of pool-riffle form to low bed relief form annel(s) In of island(s) In of island(s) In of island(reworked / removed Sum of indices = Stability Index (SI) = (AI+DI+	e of large organic debris ree roots ~ whommon If on inside meander bends If on both sides of channel through riffle If digabion baskets / concrete walls / etc. If digabion baskets / concrete walls / etc. If basal scour >50% through subject reach If ength of previously buried pipe / cable / etc. If ength of previously buried pipe / cable / etc. If of chute(s) If of chute(s) If of chute(s) If of pool-riffle form to low bed relief form If island(s) If island(s)



Rapid Stream Assessment Technique Project Number: 25011

Date:	2025-07-08	Stream:		Marl porous	1 CBSK
Time:	9:54	Reach:		MC4	
Weather:	27°C OVECCAS	Location:		Rich mond	0.992 - 12
Field Staff:	KC HM	Watershed/Subwater	shed:	JOCK IN	166
Category	Poor	Fair	39 24	Good	Excellent
	stable	 50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common 	stable Infrequ	6 of bank network ent signs of bank ng, slumping or	> 80% of bank network stable No evidence of bank sloughing, slumping or failure
Channel	 Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m 	 Stream bend areas unstable Outer bank height 0.9-1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m 	Outer by mabove 1.5 m a for larger	bend areas stable bank height 0.6-0.9 re stream bank (1.2- above stream bank re mainstem areas) verhang 0.6-0.8 m	Stream bend areas very stable Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstern areas) Bank overhang < 0.6 m
Stability	Young exposed tree roots abundant > 6 recent large tree falls per stream mile	Young exposed tree roots common 4-5 recent large tree falls per stream mile	predom large, s scarce 2-3 red	d tree roots ninantly old and smaller young roots tent large tree falls eam mile	Exposed tree roots old, large and woody Generally 0-1 recent large tree falls per stream mile
	Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised	 Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised 	Bottom genera	n 1/3 of bank is lly highly resistant oil matrix or material	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material
	Channel cross-section is generally trapezoidally- shaped	 Channel cross-section is generally trapezoidally- shaped 		el cross-section is Ily V- or U-shaped	Channel cross-section is generally V- or U-shaped
Point range	□ 0 □ 1 □ 2	□ 3 □ 4 □ 5		6 🕱 7 🗆 8	□ 9 □ 10 □ 11
	> 75% embedded (> 85% embedded for large mainstem areas)	50-75% embedded (60- 85% embedded for large mainstem areas)	59% e	% embedded (35- mbedded for large em areas)	Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)
page	Few, if any, deep pools Pool substrate composition >81% sand- silt	Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt	pools Pool su	ate number of deep ubstrate composition % sand-silt	High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) Pool substrate composition <30% sand-silt
Channel Scouring/ Sediment	Streambed streak marks and/or "banana"-shaped sediment deposits common	Streambed streak marks and/or "banana"-shaped sediment deposits common	and/or	nbed streak marks "banana"-shaped ent deposits Imon	Streambed streak marks and/or "banana"-shaped sediment deposits absent
Deposition	Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area	Fresh, large sand deposits common in channel Small localized areas of fresh sand deposits along top of low banks	uncom Small fresh	large sand deposits mon in channel localized areas of sand deposits along low banks	Presh, large sand deposits rare or absent from channel No evidence of fresh sediment deposition on overbank
(See a) Jacob	Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	Point bars common, moderate to large and unstable with high amount of fresh sand	well-ve		stable, well-vegetated and/or armoured with little or no fresh sand
Point range	□ 0 □ 1 □ 2	D 3 D 4		□ 5 X 6	D 7 D 8

Version #2 Last edited: 10/02/2023

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____



Date: 2	025-07-08	PN: 25011	Location:	orlborough creek
Category	Poor	Fair	Good	Excellent
	 Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas) 	Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)
	beminated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	Few pools present, riffles and runs dominant. Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)	Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow	Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
Physical Instream Habitat	Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble	Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble	Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble	Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble
Habitat	• Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm for large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	Riffle depth > 20 cm for large mainstem areas
	Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	cm deep (91-122 cm for large mainstem areas) with some overhead	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
-ho lobs.	Extensive channel alteration and/or point bar formation/enlargement	 Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement 	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1; ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	• Summer afternoon water temperature > 27°C	 Summer afternoon water temperature 24-27°C 	Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C
Point range	00102	□ 3 🔏 4	□ 5 □ 6	0708
	Substrate fouling level: High (> 50%)	Substrate fouling level: Moderate (21-50%)	Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)
Water Quality	Brown colour TDS: > 150 mg/L	Grey colourTDS: 101-150 mg/L	Slightly grey colour TDS: 50-100 mg/L	Clear flowTDS: < 50 mg/L
vaca. Quanty	Objects visible to depth < 0.15m below surface	Objects visible to depth 0.15-0.5m below surface	Objects visible to depth 0.5-1.0m below surface	Objects visible to depth 1.0m below surface
	Moderate to strong organic odour	Slight to moderate organic odour	Slight organic odour	• No odour
Point range	00102	□ 3 ☑ 4	□ 5 □ 6	□ 7 □ 8
Riparian Habitat	Narrow riparian area of mostly non-woody vegetation	Riparian area predominantly wooded but with major localized gaps	Forested buffer generally 31 m wide along major portion of both banks	Wide (> 60 m) mature forested buffer along both banks
Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	 Canopy coverage: 50- 60% shading (30-44% for large mainstem areas) 	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	□ 0 □ 1	2 0 3	4 5	0607
Total overall se	core (0-42) = 23	Poor (<13)	air (13-24) Good (25-3	4) Excellent (>35)
Version #2 Last edited: 10	Senio 0/02/2023	r staff sign-off (if required):	Checked by:	Completed by: HM

Page 2 of 2

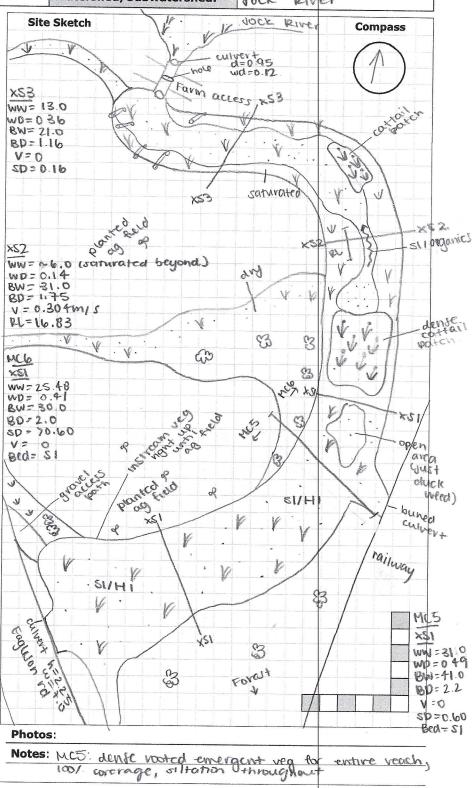


General Site Characteristics

Project Number: 25011

Date:	2025-07-08	Stream:	Mariborough creek
Time:	10:45	Reach:	MC5/MCG
Weather:	25°C overcast	Location:	Richmond, ON
Field Staff:	KC HM	Watershed/Subwatershed:	Jock River

Field	Staff:	KC	HM									
Featu	res	Monit	oring									
	Reach break	-0-0-0-	Long-profile									
只	Station location	—	Monumented XS									
*	Cross-section	0	Monumented photo									
	Flow direction	IT	Monumented photo									
~~	Riffle	₩	direction									
	Pool		Sediment sampling									
WHID)	Sediment bar	шш	Erosion pins									
######################################	Eroded bank/slope	8	Scour chains									
	Undercut bank	Additi	onal Symbols									
XXXXXX	Bank stabilization											
	Leaning tree											
XX	Fence											
	Culvert/outfall											
	Swamp/wetland											
$\Psi\Psi\Psi$	Grasses		p.									
	Tree											
	Instream log/tree											
* * *	Woody debris											
*******	Beaver dam											
VV	Vegetated island											
Flow T	уре											
H1	Standing water H1	A Back	water									
H2	Scarcely perceptible flow											
НЗ	Smooth surface flow											
H4	Upwelling		4									
H5	Rippled											
Н6	Unbroken standing w	ave										
H7	Broken standing wav	e	8 8									
Н8	Chute											
H9	Free fall H9/	N Dissip	pates below free fall									
Substr												
S1	Silt	S6	Small boulder									
S2	Sand	S7	Large boulder									
S3	Gravel	S8	Bimodal									
S4	Small cobble	S9	Bedrock/till									
S5	Large cobble											
Other BM	Benchmark	EP	Erocion nin									
BS	Backsight	RB	Erosion pin									
DS	Downstream		Rebar									
WDJ	Woody debris jam	US	Upstream									
VWC	Valley wall contact	TR	Terrace									
BOS	Bottom of slope	FC	Flood chute									
	and the second s	FP	Flood plain									
TOS	Top of slope	KP	Knick point									



Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Page _____ of ____



Date:	teris	2025-07			Field			KC HM			Wate	rshed/S	ubwate	ershed:	100	t R	iver.	
Time:		10:45	0.0		Strea			Marpororio	in C	rcck		(Upstrea	North Colonia					7
		overcast	1 250	Na .	Reach			MC5	<u> </u>			(Downst						
Weather: Land Use	V	alley Type	,	Channel		2		nnel Zone	2	low Type		•	-	roundwat	ter Loc	ation:	Р	hoto:
(Table 1)	T) (T	able 2)	8	(Table 3)		di-	(Tab		San Street Charles	Table 5)								
Riparian Veget	ation							Aquatic & II	nstrea	m Vegetat	ion			Wat	er Qu	ality		
Dominant Type (Table 6)	١	Coverage None Fragmente	ø	- 4	Age (yrs) □ Immatui ☑ Establish	re (<5)	0)	Type (Table 8)		Voody Debris ∃ In Cutbank ∃ In Channel	Low	WDJ	/50m:		Odoi (Table			rbidity able 17)
Encroachment (Table 7)	1	☐ Continuous			□ Mature (Reach Coverage %	100	Not Presen	t □ High	L						
Channel Chara	cteris	tics	1. 1.															
Sinuosity Type (Table 9)	- (ty Degre (Table 10		Bank	Angle 30		Bank Erosion		(Table 19) Bank	Clay/S	ilt Sai		avel Co	bble	Boulder	Parent	Rootlets
Gradient (Table 11)	angetes (i		Channel (Table 12		□ 30 □ 60			□ 5 - 30% □ 30 - 60%		Riffle Pool								
Entrenchment (Table 13)	's participation		nk Failur (Table 14		□Un	dercut		□ 60 - 100%		Bed (if no riffle-pool morphology)	1	E]					
Down's Model (Table 15)	D	Bankfull I	ndicators (Table 18					Bankfull Width (m)	41.0			\	Vetted \	Width (m	31	.0		
Sed Sorting (Table 20)	mod	Sediment 1	Transpor bserved		ØNo □	Not Visib	le	Bankfull Depth (m)					Vetted I	Depth (m	n) 0.	49		
Transport Mode (Table 21)	3	% of B	ed Activ	e 0				Undercuts (m)	0				Velo	city (m/s	s) (C			
Geomorphic Units (Table 22)	9		1ovemen (Table 23					Pool Depth (m)					Velocit	y Estimat Metho		В		
Riffle-Pool Spacing (m):			% Riffles	. 0	% Pool	s: D	R	liffle Length (m)				М	eander /	Amplitud (n				
Notes:																		
Ripana	n co	ondinons:	ngh	t ban	e force	+, 6	ft_	bank no	npan	an buf	fer -> 0	g he	d					
Dense o	write	am, not	cd ev	nerge	or ve	getat	(OV)	CONCAZ 100	1. 0	f veach	0							A CONTRACTOR OF THE PARTY OF TH

Photos:																		

Version #4 Last edited: 04/04/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____



KC.

Project Number: 25011 Rapid Geomorphic Assessment mariborough creck Stream: Date: 2025-07-08 Reach: MC5 Time: 10:45 Location: Richmond, ON Weather: overcas t 250 Watershed/Subwatershed: dock River Field Staff: K.C HM Present? Factor Geomorphological Indicator **Process** Value Yes Description No. Lobate bar 1 Coarse materials in riffles embedded 2 Siltation in pools 3 Evidence of Medial bars Aggradation 4 (AI) Accretion on point bars 5 Poor longitudinal sorting of bed materials 6 Deposition in the overbank zone 7 Sum of indices = Exposed bridge footing(s) 1 Exposed sanitary / storm sewer / pipeline / etc. 2 IA Elevated storm sewer outfall(s) 3 Undermined gabion baskets / concrete aprons / etc. 4 Evidence of Scour pools downstream of culverts / storm sewer outlets NIA 5 Degradation Cut face on bar forms 6 (DI) Head cutting due to knickpoint migration 7 Terrace cut through older bar material 8 Suspended armour layer visible in bank 9 Channel worn into undisturbed overburden / bedrock 10 Sum of indices = Fallen / leaning trees / fence posts / etc. 1 2 Occurrence of large organic debris Exposed tree roots 3 Basal scour on inside meander bends 4 Evidence of Basal scour on both sides of channel through riffle 5 Widening Outflanked gabion baskets / concrete walls / etc. NIA 6 (WI) Length of basal scour >50% through subject reach 7 Exposed length of previously buried pipe / cable / etc. 1A 8 9 Fracture lines along top of bank WIA Exposed building foundation 10 Sum of indices = 0 Formation of chute(s) 1 Single thread channel to multiple channel 2 Evidence of Evolution of pool-riffle form to low bed relief form 3 Planimetric Cut-off channel(s) Form 4 Adjustment Formation of island(s) 5 (PI) Thalweg alignment out of phase with meander form 6 Bar forms poorly formed / reworked / removed Sum of indices =

Notes:	Stability Index	bility Index (SI) = $(AI+DI+WI+PI)/4 = C$				
	In Regime	In Transition/Stress	In Adjustment			
	፟ 0.00 - 0.20	□ 0.21 - 0.40	□ 0.41			
		78				



Rapid Stream Assessment Technique Project Number: 25011

Date:	2025-07-08	Stream:		Mar borough	Mek				
Time:	10. 45	Reach:		MC5					
Weather:	25°C overcout	Location:		richmond, o	N				
Field Staff:	KC HM	Watershed/Subwate	ershed:	Jock Kinen					
Category	Poor	Fair		Good	Excellent				
	 < 50% of bank network stable Recent bank sloughing, slumping or failure frequently observed 	50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common	stable • Infreque	of bank network ent signs of bank ng, slumping or	> 80% of bank network stable No evidence of bank sloughing, slumping or failure				
Channel	 Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m 	Stream bend areas unstable Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m	Outer batter batter batter above 1.5 m all for larger batter	bend areas stable ank height 0.6-0.9 e stream bank (1.2- bove stream bank e mainstem areas) erhang 0.6-0.8 m	Stream bend areas very stable Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) Bank overhang < 0.6 m				
Stability	 Young exposed tree roots abundant > 6 recent large tree falls per stream mile 	Young exposed tree roots common 4-5 recent large tree falls per stream mile	predomi large, sr scarce	tree roots nantly old and maller young roots nt large tree falls am mile	Exposed tree roots old, large and woody Generally 0-1 recent large tree falls per stream mile				
	Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised	Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised	generally	1/3 of bank is y highly resistant Il matrix or material	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or materia				
	Channel cross-section is generally trapezoidally- shaped	• Channel cross-section is generally trapezoidally-shaped		cross-section is V- or U-shaped	Channel cross-section is generally V- or U-shaped 9 0 10 0 11				
Point range	00102	□ 3 □ 4 □ 5	□ 6	7 08					
niffus	85% embedded for large mainstem areas)	 50-75% embedded (60- 85% embedded for large mainstem areas) 	• 25-49% 59% eml mainsten	embedded (35- bedded for large n areas)	Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)				
	composition >81% sand- silt	 Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt 	pools	strate composition	High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) Pool substrate composition <30% sand-silt				
Channel Scouring/ Sediment Deposition	and/or "banana"-shaped sediment deposits common	 Streambed streak marks and/or "banana"-shaped sediment deposits common 	 Streamber and/or "b sediment uncommo 		Streambed streak marks and/or "banana"-shaped sediment deposits absent				
	deposits very common in channel	 Fresh, large sand deposits common in channel Small localized areas of fresh sand deposits along top of low banks 	 uncommo Small loca 	ge sand deposits on in channel alized areas of deposits along banks	 Fresh, large sand deposits rare or absent from channel No evidence of fresh sediment deposition on overbank 				
no pbs.	Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	Point bars common, moderate to large and unstable with high amount of fresh sand	well-vege	s small and stable, tated and/or with little or no d	 Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand 				
Point range	□ 0 □ 1 □ 2	□ 3 🗹 4		5 🗆 6	□ 7 □ 8				

Version #2 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by:



ate: 202	5-07-08	PN: 25011	Location:	tichmond ow
Category	Poor	Fair	Good	Excellent
	Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	• Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	Wetted perimeter > 85% of bottom channel width (> 90% for large mainstern areas)
	Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	Few pools present, riffles and runs dominant. Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)	 Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow 	Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water) Riffles, runs and pool habitation.
wff() Physical Instream	Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble	Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble	 Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble 	 Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble
Habitat	Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm fo large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	Riffle depth > 20 cm for large mainstem areas
	Large pools generally 30 cm deep (< 61 cm fpr large mainstem areas) and devoid of overhead cover/structure	Large pools generally 30 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structur	cm deep (91-122 cm for large mainstem areas) with some overhead	cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	Extensive channel alteration and/or point bar formation/enlargement	Moderate amount of channel alteration and/o moderate increase in point bar formation/enlargement	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	No channel alteration or significant point bar formation/enlargement
	Riffle/Pool ratio 0.49:1; ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
	• Summer afternoon water temperature > 27°C	• Summer afternoon water temperature 24-27°C	• Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C
Point range	□ 0 □ 1 □ 2	⊿3 □ 4	5 6	□ 7 □ 8
	• Substrate fouling level: High (> 50%)	Substrate fouling level: Moderate (21-50%)	Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)
	Brown colour TDS: > 150 mg/L	Grey colour TDS: 101-150 mg/L	• Slightly grey colour • TDS: 50-100 mg/L	• Clear flow • TDS: < 50 mg/L
Water Quality	Objects visible to depth < 0.15m below surface	Objects visible to depth 0.15-0.5m below surface	Objects visible to depth 0.5-1.0m below surface	Objects visible to depth > 1.0m below surface
	Moderate to strong organic odour	Slight to moderate organic odour	Slight organic odour	• No odour
Point range	□ 0 □ 1 □ 2	□ 3 □ 4	対 5 □ 6	□ 7 □ 8
Riparian	Narrow riparian area of mostly non-woody vegetation	Riparian area predominantly wooded but with major localized gaps	Forested buffer generally 31 m wide along major portion of both banks	Wide (> 60 m) mature forested buffer along both banks
Habitat Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	Canopy coverage: 50- 60% shading (30-44% for large mainstem areas)	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	□ 0 Ø 1	□ 2 □ 3	4 5	□ 6 □ 7
Total overall	score (0-42) = 2	Poor (<13)	Fair (13-24) Good (25	5-34) Excellent (>35)

Last edited: 10/02/2023



2025-07- 10: 45 25 C ove Valley Type (Table 2) ion Coverage None Fragmented Continuous	rcast	Age (yrs) ☐ Immature (☐ Established (5)</th <th>Cha (Tal</th> <th>May boyon MCb annel Zone ble 4) Aquatic & In Type</th> <th>agh 2mg</th> <th>Flow Ty (Table 5</th> <th>pe)</th> <th></th> <th>tream): vnstrear</th> <th>n): Groundw</th> <th>vater Loc</th> <th>roung wation: Thi</th> <th>ver</th> <th>noto:</th>	Cha (Tal	May boyon MCb annel Zone ble 4) Aquatic & In Type	agh 2mg	Flow Ty (Table 5	pe)		tream): vnstrear	n): Groundw	vater Loc	roung wation: Thi	ver	noto:
25 C OVE Valley Type (Table 2) ion Coverage None Fragmented	Channel Channel Widths	Age (yrs) Immature (<:	(Tal	Aquatic & I	Jan s	Flow Ty (Table 5	pe)	TE		Groundw	rater Loc	ation: <u>{hi</u>	rater st oughoul P	hoto:
Valley Type (Table 2) ion Coverage None Fragmented	Channel Channel Widths	Age (yrs) Immature (<:	(Tal	Aquatic & I	Allenn s	(Table 5) <u> </u>	TE		Groundw	rater Loc	ation: <u>{hi</u>	vater si oughoui p	hoto:
Coverage □ None Pragmented	.⊒1 - 4 □ 4 - 10	☐ Immature (<br ☐ Established (5	5)	Type	nstrea	ım Vege	tatio	n		W:		-1:4		
□ None □ Pragmented	.⊒1 - 4 □ 4 - 10	☐ Immature (<br ☐ Established (5	5)				Latio			U	ater Qu	anty		
	.,	☐ Mature (>30)	- 1	(135,5 5)	4	Woody De ☑ In Cuth ☐ In Chai ☐ Not Pre	ank .	□ Mod	WDJ/50m		Odou (Table			rbidity ble 17)
eristics				[9		
		Bank Ang	le	Bank Erosion			1500	Clay/Silt	Sand	Gravel	Cobble	Boulder	Parent	Rootlets
		□ 30 − 60 □ 60 − 90		□ 5 - 30% □ 30 - 60%										
		□ Undercu	t	□ 60 – 100%	P	(if no riffle-	loool							
				Bankfull Width (m)	30.0		1,0	21.0	Wette	d Width (m) 25.	48	4.0	(3.0
		es 🗖 No 🗆 Not Vi	isible	Bankfull Depth (m)] [.75	1.16	Wette	d Depth (m) 0.4		0.14	6.36
2 .	/			Undercuts (m)		4	O	0]				.30A-	0
				Pool Depth (m)						Met	hod W	e	w8	Sw
%	Riffles: 5	% Pools:		Riffle Length (m)					Meande		- 1			
nergent/floo	farm cos	organ vege	taha e u	ntivence u	mast	of I	rach	cduck	weed,					
Activities 1			June				.,							
							7		1					
	Bankfull Inc Sediment Tr Ob: Mass Mo (1) Mass Mo (1) We will a generally be racht / floor Verit under	Sediment Transport Observed? % of Bed Active Mass Movement (Table 23) % Riffles: % Riffles: 5 As generally stagian ergent/floating instagian ergent/floating instagian ergent/floating instagian ergent/floating instagian	# of Channels (Table 12) # of Channels (Table 12) Bank Failure (Table 14) Bankfull Indicators (Table 18) Sediment Transport Observed? Wass Movement (Table 23) Riffles: White Property Riffles: White Property Wash Active Riffles: White Property With divided the property With divided the property We were under farm crossing before	(Table 10)	# of Channels (Table 10) # of Channels (Table 12) Bank Failure (Table 14) Bankfull Indicators (Table 18) Sediment Transport Observed? What Mass Movement (Table 23) What Mass Movement (Table 24) What Mass Movement (Table 23) What Mass Movement (Table 24) What Mass Moveme	# of Channels (Table 12)	# of Channels 30 - 30 55% Ba # of Channels 30 - 60 5 - 30% Riff (Table 12) 60 - 90 30 - 60% Pc Bank Failure (Table 14) Undercut 60 - 100% Bankfull Indicators (Table 18) 3,5 Bankfull Width (m) 30.0 3 Sediment Transport Yes No Not Visible Bankfull Depth (m) 20 1 Whass Movement (Table 23) Pool Depth (m) Pool Dept	Clable 10 20 - 30 25% Bank	# of Channels 30 - 30 55% Bank	# of Channels (Table 12) 30 - 60 5 - 30% Riffle 2 Bank Failure Undercut 60 - 100% Bed (If no riffle-pool morphology) Bankfull Indicators (Table 18) 3, 5 Bankfull Width (Im) 30.0 31.0 21.0 Wette (Im) 20 1.75 1.10 1.10 1.10 1.10 1.10 1.10 1.10 1.10 1.10 1.10	# of Channels (Table 12)	# of Channels (Table 12)	# of Channels (Table 12)	# of Channels 30 - 60 5 - 30% Riffle

Last edited: 04/04/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____



Project Number: 25011 **Rapid Geomorphic Assessment** 2025-07-08 Marlborodg120M Date: Stream: creek Time: :00 Reach: ich mon à overcas + Weather: Location: Field Staff: HM Tock river Watershed/Subwatershed: Geomorphological Indicator Present? Factor **Process** No. Description Value Yes No Lobate bar 1 2 Coarse materials in riffles embedded 3 Siltation in pools Evidence of Aggradation 4 Medial bars (AI) 5 Accretion on point bars 6 Poor longitudinal sorting of bed materials Deposition in the overbank zone Sum of indices = Exposed bridge footing(s) N 2 Exposed sanitary / storm sewer / pipeline / etc. 3 Elevated storm sewer outfall(s) N 4 Undermined gabion baskets / concrete aprons / etc. Evidence of 5 Scour pools downstream of culverts / storm sewer outlets Degradation 6 Cut face on bar forms (DI) 7 Head cutting due to knickpoint migration Terrace cut through older bar material 8 9 Suspended armour layer visible in bank N 10 Channel worn into undisturbed overburden / bedrock 0 Sum of indices = 1 Fallen / leaning trees / fence posts / etc. 2 Occurrence of large organic debris 3 Exposed tree roots 4 Basal scour on inside meander bends Evidence of 5 Basal scour on both sides of channel through riffle Widening 6 Outflanked gabion baskets / concrete walls / etc. N (WI) 7 Length of basal scour >50% through subject reach 8 Exposed length of previously buried pipe / cable / etc. 9 Fracture lines along top of bank 10 Exposed building foundation N Sum of indices = 1 Formation of chute(s) 2 Single thread channel to multiple channel Evidence of 3 Evolution of pool-riffle form to low bed relief form Planimetric Form 4 Cut-off channel(s) Adjustment 5 Formation of island(s) (PI) 6 Thalweg alignment out of phase with meander form Bar forms poorly formed / reworked / removed Sum of indices =

Notes:	Stability Index	Stability Index (SI) = (AI+DI+WI+PI)/4 = 0, 4					
	In Regime	In Transition/Stress	In Adjustment				
	岚 0.00 - 0.20	□ 0.21 - 0.40	□ 0.41				

Version #3 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____



Rapid Stream Assessment Technique Project Number: 25011

Date:	2025-07-08	Stream:	Stream: $ ho^{\iota}$		Wall polonar CI		
Time: 11:00 Reach: Weather: 27°(0) VCOSt Location:			WCE	ajune.			
		Richmona					
Field Staff:	KC HM	Watershed/Subwater	rshed:	JOCK rive			
Category	Poor	Fair	grup elem :	Good		Excellent	
	 < 50% of bank network stable Recent bank sloughing, slumping or failure frequently observed 	50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common	stable • Infrequ	o of bank network ent signs of bank ng, slumping or	stable • No evic	of bank network ence of bank ng, slumping or	
Channel	Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m	Stream bend areas unstable Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m	Outer be mabove 1.5 m a for larger	bend areas stable ank height 0.6-0.9 e stream bank (1.2- above stream bank e mainstem areas) verhang 0.6-0.8 m	stable • Height stream stream mainste	bend areas very0.6 m above1.2 m abovebank for largem areas)verhang < 0.6 m	
Stability	Young exposed tree roots abundant > 6 recent large tree falls per stream mile	Young exposed tree roots common	 Young exposed tree roots common 4-5 recent large tree falls • Exposed tree roots predominantly old and large, smaller young roots • Exposed tree roots • Exposed tree roots • Predominantly old and large, smaller young roots • • Predominantly old and large, smaller young roots 		large a Genera	d tree roots old, nd woody lly 0-1 recent large ls per stream mile	
	Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised	Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material		genera	1/3 of bank is ly highly resistant oil matrix or material		
	Channel cross-section is generally trapezoidally- shaped	• Channel cross-section is generally trapezoidally-shaped		l cross-section is lly V- or U-shaped	1 0 2 3 3 4 5 5	l cross-section is ly V- or U-shaped	
Point range	00102	3 4 5	□ 6	5 人 7 口 8	□ 9	□ 10 □ 11	
8 10 9 St 6 8 19 St 6 8	> 75% embedded (> 85% embedded for large mainstem areas)	• 50-75% embedded (60- 85% embedded for large mainstem areas)	59% er	6 embedded (35- nbedded for large em areas)	25% sa embed	mbeddedness < and-silt (< 35% ded for large em areas)	
	Few, if any, deep pools Pool substrate composition >81% sand- silt	Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt	Moderate number of deep pools Pool substrate composition 30-59% sand-silt		(> 61 c (> 122 mainst • Pool su	Imber of deep pools m deep) cm deep for large em areas) bstrate composition sand-silt	
Channel Scouring/ Sediment	Streambed streak marks and/or "banana"-shaped sediment deposits common	ed and/or "banana"-shaped and sediment deposits sed		bed streak marks "banana"-shaped nt deposits mon	and/or	bed streak marks "banana"-shaped nt deposits absent	
Deposition	Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area	 Fresh, large sand deposits deposits common in channel Small localized areas of fresh sand deposits along top of low banks Fresh, large sand deposits uncommon in channel Small localized areas of fresh sand deposits along top of low banks 		mon in channel ocalized areas of and deposits along	rare or • No evid	large sand deposits absent from channe dence of fresh nt deposition on nk	
	Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand	Point bars common, moderate to large and unstable with high amount of fresh sand	oars common, rate to large and ole with high • Point ba well-veg armoure		stable, and/or	ars few, small and well-vegetated armoured with little esh sand	
Point range	□ 0 □ 1 □ 2	□ 3 □ 4		□ 5 対 6		7 0 8	

Version #2 Last edited: 10/02/2023

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____



ORPHIX

Date: 20	125-07-08	PN: 25011	Location: R	(ick word	
Category	Poor	Fair	Good	Excellent	
	Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	Wetted perimeter > 85% or bottom channel width (> 90% for large mainstem areas)	
Physical Instream Habitat	Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	 Few pools present, riffles and runs dominant. Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate) 	Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow	Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water) Riffles, runs and pool habitation flow present (i.e., slow, fast, shallow and deep water)	
	Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble	 Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble 	 Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble 	 Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble 	
	Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm for large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	Riffle depth > 20 cm for large mainstem areas	
	Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure	Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure	
	Extensive channel alteration and/or point bar formation/enlargement	Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	No channel alteration or significant point bar formation/enlargement	
	• Riffle Pool ratio 0.49:1 ; ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	Riffle/Pool ratio 0.9-1.1:1	
www.	• Summer afternoon water temperature > 27°C	 Summer afternoon water temperature 24-27°C 	Summer afternoon water temperature 20-24°C	• Summer afternoon water temperature < 20°C	
Point range	□ 0 □ 1 □ 2	□ 3 💆 4	□ 5 □ 6	0708	
	• Substrate fouling level: High (> 50%)	Substrate fouling level: Moderate (21-50%)	Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)	
Water Quality	Brown colour TDS: > 150 mg/L	• Grey colour • TDS: 101-150 mg/L	Slightly grey colour TDS: 50-100 mg/l	• Clear flow • TDS: < 50 mg/L	
water Quanty	 Objects visible to depth 0.15m below surface 	 Objects visible to depth 0.15-0.5m below surface 	Objects visible to depth 0.5-1.0m below surface	Objects visible to depth > 1.0m below surface	
2.0	 Moderate to strong organic odour 	 Slight to moderate organic odour 	Slight organic odour	No odour	
Point range	□ 0 □ 1 □ 2	□ 3 □ 4	□ 5 📜 6	0708	
Riparian Habitat	Narrow riparian area of mostly non-woody vegetation	Riparian area predominantly wooded but with major localized gaps	Forested buffer generally 31 m wide along major portion of both banks	Wide (> 60 m) mature forested buffer along both banks	
Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	 Canopy coverage: 50- 60% shading (30-44% for large mainstem areas) 	 Canopy coverage: 60-79% shading (45-59% for large mainstem areas) 	Canopy coverage: >80% shading (> 60% for large mainstem areas)	
Point range	0 0 1	□ 2 □ 3	0405	□ 6 □ 7	
rotal overall s	core (0-42) = 24	Poor (<13)	air (13-24) Good (25-:	34) Excellent (>35)	

Version #2 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

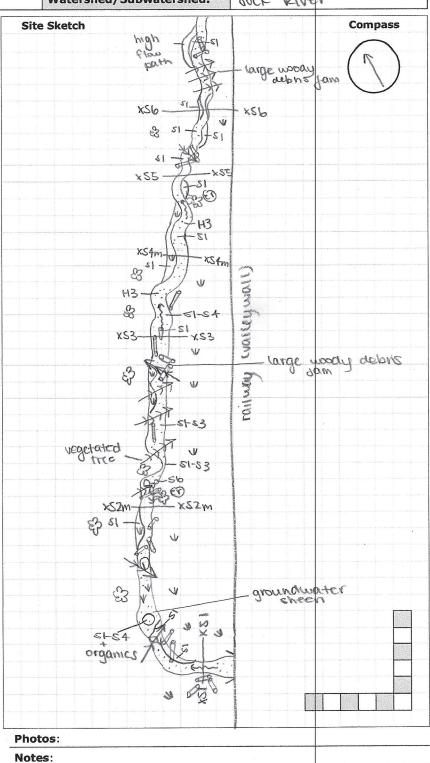


General Site Characteristics

Project Number: 25011

Date:	2025-07-09	Stream:	Marlbovough cheek
Time:	แ:53	Reach:	MC3
Weather:	Sunny 28°C	Location:	Richmond LON
Field Staff:	HM KC	Watershed/Subwatershed:	dock river

Field S	Staff:	H	M KC
Featur	es	Monit	oring
	Reach break	-0-0-0-	Long-profile
ス	Station location	L	Monumented XS
xx	Cross-section	0	Monumented photo
	Flow direction		Monumented photo
~~	Riffle	₩	direction
	Pool		Sediment sampling
	Sediment bar		Erosion pins
 	Eroded bank/slope	8	Scour chains
	Undercut bank	Additi	ional Symbols
XXXXXX	Bank stabilization		
->>>	Leaning tree		
XX	Fence		
	Culvert/outfall		9
	Swamp/wetland		
WWW	Grasses		20
C	Tree		
	Instream log/tree		9
***	Woody debris		
WWW WWW	Beaver dam		
CONTRACTOR CONTRACTOR	Vegetated island		
Flow T			
H1	Standing water H1		water
H2	Scarcely perceptible		
H3	Smooth surface flow	1	
H4	Upwelling		
H5	Rippled	2024a - 522	
H6	Unbroken standing		
H7	Broken standing wa	ve	
H8	Chute		
H9	Free fall H9	A Diss	sipates below free fall
Substr			
S1	Silt	Se	
S2	Sand	S	7 Large boulder
S3	Gravel	S	Dillioud.
54	Small cobble	SS	Bedrock/till
S5	Large cobble		
Other			
ВМ	Benchmark	EP	Erosion pin
BS	Backsight	RB	Rebar
DS	Downstream	US	Upstream
WDJ	Woody debris jam	TR	Terrace
vwc	Valley wall contact	FC	Flood chute
BOS	Bottom of slope	FP	Flood plain
TOS	Top of slope	KP	Knick point
	F 3. 3.3P3		



Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Page 1 of 2

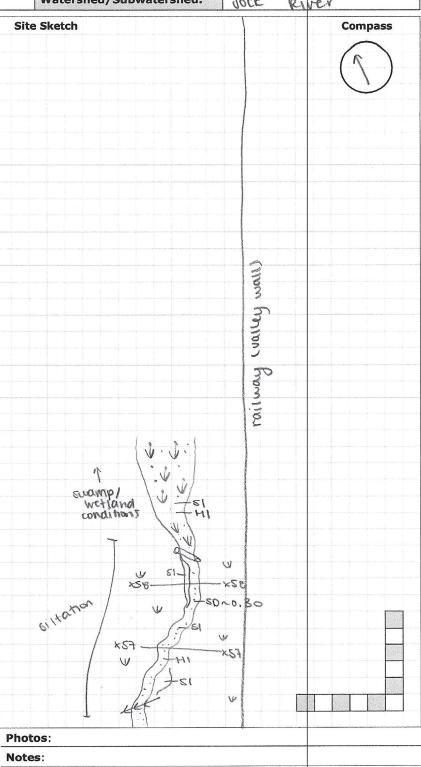


General Site Characteristics

Project Number: 25011

Date:	2025-07-09	Stream:	Mariborough CHEK
Time:	12:35	Reach:	MC3
Weather:	sunny 28°C	Location:	Richmond, on
Field Staff:	HM KC	Watershed/Subwatershed:	dock River

Field S	Staff:	1H	1 KC	en e
Featur	es	Monito	ring	Site
	Reach break	-0-0-0 I	ong-profile	
只	Station location	 	Monumented XS	
××	Cross-section		Monumented photo	
	Flow direction		Monumented photo	
~~	Riffle	▼ (direction	
	Pool	Name of Street	Sediment sampling	
CHAND			Erosion pins	
	Eroded bank/slope		Scour chains	
	Undercut bank	Additio	nal Symbols	
	Bank stabilization			
$\twoheadrightarrow\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	Leaning tree			
XX	Fence			
	And the second s			
	Swamp/wetland/du	ck wee	A	
$\Psi\Psi\Psi$	Grasses			
	Tree			
	Instream log/tree			
* * *	Woody debris			
*****	Beaver dam			
WV	Vegetated island			
Flow T	уре			
H1	Standing water H1	A Back v	vater	
H2	Scarcely perceptible	flow		
H3	Smooth surface flow			
Н4	Upwelling			
H5	Rippled			
H6	Unbroken standing v	wave		
H7	Broken standing way	ve		
H8	Chute			
Н9	Free fall H9	A Dissip	ates below free fall	
Substr	ate			
S1	Silt	S6	Small boulder	
S2	Sand	S7	Large boulder	
S 3	Gravel	S8	Bimodal	
S4	Small cobble	S9	Bedrock/till	
S5	Large cobble			
Other				
вм	Benchmark	EP	Erosion pin	
BS	Backsight	RB	Rebar	
DS	Downstream	US	Upstream	
WDJ	Woody debris jam	TR	Terrace	
vwc	Valley wall contact	FC	Flood chute	
BOS	Bottom of slope	FP	Flood plain	Phot
TOS	Top of slope	KP	Knick point	Note



Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

Page ____2 of ____



Date:	2025-07-09	Reach:	MC3	
Time:	10:48	Location:	Richmond	
Weather:	Sunny 27'c	Watershed/Subwatershed:	dock ever	
Field Staff:	Sunny 27'C	Rain in last 24 hours:	□ None □ Yes: Amount	mm
Point No.	Code	Notes	Survey Direction	
			Upstream to Downstr	ream
	flyname - PN250	26.1	☐ Downstream to Upsti	
	long profile starts		Cross-sections	
	Jording Citative	pants 30,089 + 30,090	No. of Cross-sections Surveyo	ed: B
		man need to be	Monitoring Cross-sections: □	
	2-869	may need to be removed	XS ID: 2 / 4 /	
	1-WL		Erosion Pin Installed: ☐ No	
			XS ID: 2 / 4 /	
		,	Velocity & Sediment Trans	
			□ Dischargem/s Met	*7
			Sed. Transport (Table 21):	1
			□ Saltation □ Sliding □	Rolling
			Percentage of Bed Active:	
		***	Valley Type	
		The state of the s	☐ Confined ☑ Partially ☐	Unconfined
			Channel Zone	
			☐ Headwater ☐ Transfer ☐	Deposition
			Land Use	
			Forcit	
			Vegetation	
			Aquatic Vegetation: float	ing/ roots
			Coverage of Reach: 85	%
			☑ In Stream ☑ Margins □ C	1
			Riparian Vegetation:	
			Extent of Riparian Cover:	•
			☐ Fragment ☐ None ☑	Continuous
		44	Riparian Cover (channel w	
			Ø1-4 ^{KB} □4-10	≥10 B
			Age Class of Riparian Vege	
			Immature Established	Mature
			☐ (<5 yrs)	
	,		Extent of Encroachment:	//
				Moderate
		2	1	ktreme
			Density of Woody Debris:	01110
			□ Low ☑ Moderate	□ High
			Blockage(s) in Channel:	_ mgn

Version #3 Last edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

 $\ \square \ Infrastructure$

□ Dam \square LWD

Page ____ of ___



Detailed Cross-Section Characteristics

Project Number: 25011

Date:	2075-07-09	Cross-section:	XSI	
Time:	10:56	Reach:	MC3	
Weather:	Sunny 27°C	Location:	Richmond	
Field Staff:	KE HM	Watershed/Subwatershed:	dock River	

		,			Notes
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Sub	strat	te Sa	mple	:							
	□Ве	ed 🗆	Bank	⟨ □ S	ubpa	veme	nt 🗆	Wate	er Z	None	
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Version #4

Last edited: 2025-03-04

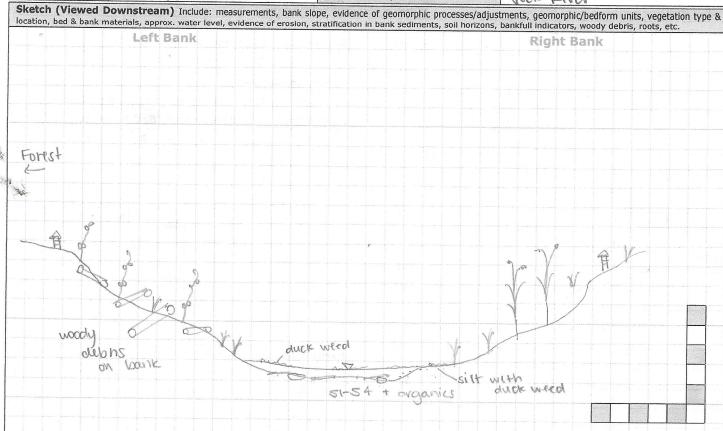
Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

Bank Characteristics

Project Number: 25011

M	0	R	P	Н	1	X "

Date:	2025-07-09	Cross-section:	X81	
Time:	10:56	Reach:	MC3	100
Weather:	Sunny 27'C	Location:	Richmond	
Field Staff:	KC HIM	Watershed/Subwatershed:	Jock River	
		the state of the s	A I CANA	



bank materials	Left Bank Materials							
☐ Gravel								
☐ Small Cobble								
☐ Large Cobble								
☐ Small Boulder								
☐ Large Boulder								
062	m							
15	0							
0.10	m							
15	%							
0	m							
	m							
1,0	kg/cm ²							
0.25	kg/cm ²							
☐ Yes ☑ No								
	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ 15 □ 0.10 □ 15 □ 0.10 □ 15							

	Features
只	Station location
	Monumented XS
0	Monumented photo
	Undercut bank
<i>HHHH</i>	Eroded bank/slope
XXXXX	Bank stabilization
××	Fence
WWW	Grasses
	Leaning tree
	Tree
***	Woody Debris
	Sediment sample
<u> </u>	Erosion pin
8	Scour/bed chain

Righ	t Bank Materials	
☐ Bedrock	☐ Gravel	
□ Till	☐ Small Cobble	-
☐ Clay	☐ Large Cobble	
₽Silt	☐ Small Boulder	
☐ Sand	☐ Large Boulder	
Bank Height:	0.79	m
Bank Angle:	25	0
Root Depth:	0.20	m
Root Density:	15	%
Undercut:	O	m .
Erosion Pin:		m
Torvane:	1.0	kg/cm ²
Penetrometer:	0.5	kg/cm ²
Foot Used:	☐ Yes ☑ No	

Additional Notes	
	t manual
Photos:	

Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____



Detailed Cross-Section Characteristics

Project Number: 25011

Date:	2025-07-09	Cross-section:	X25 mor nucl teg
Time:	11'41	Reach:	MC3
Weather:	SUMPLY 27C	Location:	Richmond, ON
Field Staff:	KC HM	Watershed/Subwatershed:	Jock River

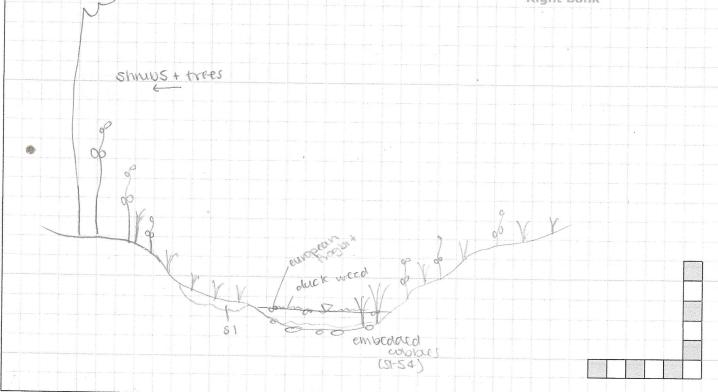
					Notes	Cr	oss-s	ectio	nal M	orpholog	ју (Та	ble 22))			
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RIL	na na lo	E011				Su	bstra	te Sa	mple							
DUNN	re- PM	- 1	. @ 2m				□В	ed [Bank	. □ Subp	aveme	ent 🗆 W	ate	r 🛮 No	ne	
	house	1) B 174 A 1	le second		- 4	Pe	bble	Coun	t Mea	sureme	nts A/	B/C Ax	ces	(cm):		
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Version #4 Last edited: 2025-03-04 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

Page 1 of 2

		Jest Hallibell 2001		
Date:	2025-07-09	Cross-section:	1852	monumented
Time:	11:41	Reach:	MC3	1
Weather:	28'C Sunny	Location:	Richmon	N
Field Staff:	KC HM	Watershed/Subwatershed:	JOCK V	
		the state of the s	A Chame L	-110.

Sketch (Viewed Downstream) Include: measurements, bank slope, evidence of geomorphic processes/adjustments, geomorphic/bedform units, vegetation type & location, bed & bank materials, approx. water level, evidence of erosion, stratification in bank sediments, soil horizons, bankfull indicators, woody debris, roots, etc. Left Bank Right Bank



	A Danie Matarial				1			
Lei	t Bank Materials			Features		Right Bank Materi		
☐ Bedrock	☐ Gravel		只	Station location	1	□ Bedrock	☐ Gravel	
□ Till	☐ Small Cobble			Monumented XS		□ Till	☐ Small Cobble	
∠ Clay	☐ Large Cobble		0	Monumented photo		Clay	☐ Large Cobble	
Silt	☐ Small Boulder			Undercut bank		⊠ Silt	☐ Small Boulder	
□ Sand	☐ Large Boulder		1111111	Eroded bank/slope		☐ Sand	☐ Large Boulder	
Bank Height:	0.65	m	XXXXX	Bank stabilization		Bank Height:	0.82	
Bank Angle:		0	X- X -X	Fence		Bank Angle:	35	
Root Depth:	0.15	m	WWW	Grasses		Root Depth:	0.20	
Root Density:	30	%		Leaning tree		Root Density:	20	
Undercut:		m	(B)	Tree		Undercut:	0	
Erosion Pin:	- DIO	m	***	Woody Debris		Erosion Pin:	20.2	
Torvane:	1. 0	kg/cm ²		Sediment sample	16	Torvane:	1.0	
Penetrometer:	0.25	kg/cm ²	ппп	Erosion pin		Penetrometer:	0.25	
Foot Used:	☐ Yes ☑ No		8	Scour/bed chain		Foot Used:	☐ Yes ☐ No	

		Scoul/bed chain	Foot Usea:	☐ Yes ☐ No
Additional Notes				
Photos:		4	3	
Version #4	Senior staff sign-off	(if required):	Charles d. b	0 11 11 1/6

Last edited: 21/02/2023

__ Checked by: _____ Completed by: __KL

_ m

kg/cm² kg/cm²



Date:

Time: Weather:

Section Characteristies	, indicate italian	23011	
2025-07-09	Cross-section:	X53	
14:59	Reach:	MC3	
sunny 28°C	Location:	Richmond	
ICC HM	Watershed/Subwatershed:	dock River	

Field St	aff:	KC HM						Watershed/Subwatershed: Jock River													
								N	lotes	Cro	SS-S6	ectio	nal M	lorpi	nolog	y (Ta	able	22)			
												□R	iffle		Pool	\\	Run		Othe	er	
	RTI		p+	35	00					Sul	ostrat	te Sa	mple	e:							
	1///	-	1							100 100 100 100 100 100 100 100 100 100	₽B	ed 🗷	Ban	k □ :	Subpa	veme	ent [Wat	er [No	ne
										Pel	oble C	No. State Control of						S111000000 (5)	9655720		
				7						A	В	С	A	В	С	A	В	¢	I	\	ВС
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	4			22							pth _									The state of the s	m/s
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 	The second secon	1			sort to	-615		17.4	NE	Air-	Hee	Vco if	Denti	1 / 0	75 m	and V-	n / Va	o if De	nth	> 0 7	5 m

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____ Completed by: HM

Page _ _ of _2_

Bank Charac	ctaristics	Droinet Namehous	MORPHI
Date:	2025-07-09	Project Number: Cross-section:	\ \\ \
Time:	14:59	Reach:	
Weather:	sunny 28°C	Location:	MC3 Richmond
Field Staff:	KC HM	Watershed/Subwatershed:	
Sketch (Viewed	Downstream) Include: measurements	5. bank slone, evidence of geomorphic processes/adjus	Jock Piver
location, bed & bank	materials, approx. water level, evidence of Left Bank	ferosion, stratification in bank sediments, soil horizons,	bankfull indicators, woody debris, roots, etc.
-9',	10585 20165 701. 91012 COVER 3017 5317	Small V-socky debris	Lerbs Ling Sing Costball Costball
Left	t Bank Materials	Features	Right Bank Materials
□ Bedrock	□ Gravel	只 Station location □	Bedrock Gravel
	☐ Small Cobble	I—I Monumented XS □	Till □ Small Cobble
☐ Clay	☐ Large Cobble	Monumented photo	Clay Large Cobble
⊠Silt	☐ Small Boulder	Undercut bank	Silt
☐ Sand	□ Large Boulder	##### Eroded bank/slope	Sand Large Boulder
Bank Height:	<u>0.5</u> m	Bank stabilization Ba	nk Height: m
Bank Angle:	15	*-*-* Fence B	ank Angle: 25 °
Root Depth:	0.05 m		oot Depth: 0.07 m
Root Density:	%		ot Density:
Undercut:	m	Tree	Undercut: m
Erosion Pin:	m		rosion Pin: m
Torvane:	kg/cm²	Sediment sample	Torvane: kg/cm ²
Penetrometer:	0.25 kg/cm ²		etrometer: kg/cm²
Foot Used:	□ Yes 🗓 No	0	Foot Used: ☐ Yes ☒ No
Additional Note	es		35 % 110

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: ____ Page _2_ of _2_

Photos:

Version #4 Last edited: 21/02/2023



Detailed Cross-Section Characteristics

Project Number: 25011

Date:		2025	-07-00	7	Cross-sect	ion:	V< A	, Mor	100	NA VO	9
Time:		12:01			Reach:		MCS	11.01	1011	41170	· ·
Weather			Sunny		Location:		Richmo	nd			
Field Sta	ff:	and with the desired	HM		Watershed	I/Subwatershe	00/20/00/01		G + 85		18
					Notes	Cross sortis	onal Morpholog	w (Table 22			
10-41.					Notes						
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						6	16	26		36	
						7	17	27		37	
						8 8 /8	18 18 18	28 28 2	18 33	3 38	
							19	29		39	
						10	20	30		40	
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						☐ Sub-angul	ar 🗆 Angular	☐ Roune	réd	</th <th>/</th>	/
		Chr. Sh. see				☐ Sub-Round	ded 🗆 Well Rou	nded	/~	$\times//$	
						Embededness	s (%):	_	(C	/5/	
						Subpavemen	t:	Гі	Pebble A	BC axis gui	ide1
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		76-77 A.S	, Eerbs§	100	rice issoj api	Sorting (Tab	le 20): 🗆 Well 🗈	☐ Moderate ☐	Poor [□ Very p	oor
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							m Width		The same of the sa		
		Maria Cara									
		HERD		(21.10) R. Z	1,135911	Use V ₆₀ if	Depth < 0.75 m a	nd V_{20} / V_{80} if D	epth >	0.75 m	

Version #4 Last edited: 2025-03-04

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____ Completed by: HM

Page ____ of _____



Bank Characteristics Project Number: 25011 Date: Cross-section: 2025-07-09 Time: Reach: MC3 12:01 Weather: Location: sunny Richmond LON 28.C Field Staff: Watershed/Subwatershed: JOCK RIVEY Sketch (Viewed Downstream) Include: measurements, bank slope, evidence of geomorphic processes/adjustments, geomorphic/bedform units, vegetation type & location, bed & bank materials, approx. water level, evidence of erosion, stratification in bank sediments, soil horizons, bankfull indicators, woody debris, roots, etc. Left)Bank Right Bank Forcs t The Kake 51-52 **Left Bank Materials Features Right Bank Materials** ☐ Bedrock ☐ Gravel 只 Station location ☐ Bedrock ☐ Gravel □ Till ☐ Small Cobble Monumented XS □ Till ☐ Small Cobble 0 ☐ Clay ☐ Large Cobble Monumented photo ☐ Large Cobble ☐ Clay ☐ Silt ☐ Small Boulder ☐ Small Boulder Undercut bank Silt HHHH☐ Sand ☐ Large Boulder Eroded bank/slope ☐ Sand ☐ Large Boulder 0.41 XXXXX 0.35 Bank Height: Bank stabilization m Bank Height: m 10 15 Bank Angle: Bank Angle: X--X-X Fence 010 0.10 Root Depth: WWW Grasses Root Depth: m m 15 30 Root Density: % ** Leaning tree Root Density: % 0 0 Undercut: m **C** Tree Undercut: m 0.20 0.20 Erosion Pin: * * * Woody Debris Erosion Pin: m m 0.75 1.0 Torvane: H Sediment sample Torvane: kg/cm² kg/cm² 0.5 0.5 Penetrometer: шш kg/cm² Erosion pin kg/cm² Penetrometer: 8 Foot Used: ☐ Yes ☑ No Scour/bed chain Foot Used: ☐ Yes ☐ No **Additional Notes**

Photos:

Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____



Detailed Cross-Section Characteristics

Project Number: 250 |

ENVIORED CONTROL SECTION AND ADDRESS OF THE PARTY OF THE			000011	4 22
Date:	2025-07-09	Cross-section:	VK-E	
Time:	3:19	Reach:	MC3	
Weather:	Sunny 28°C	Location:	Richmond	
Field Staff:	KC FIM	Watershed/Subwatershed:		

Riffle Pool Riffle			
	lun 🗉	Other	
Substrate Sample:			
RTK P1500	nt 🗆 Wa	ter 🗸 No	one
Pebble Count Measurements A/E			
A B C A B C A	ВС	A	в с
Fine3 /11	71	-	21
12 12	22	+	77
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4 4 4 14 14 24	24 24	1 34	34 T 24
	25		95 37
	26		26
	22	- Inches	55
8 (8 8 18 18 18 28	2 8 28	I	37 32/ 33
	Lo I		1100
	20		<u> </u>
Particle Shape: ☐ Platy ☐	Very An	aular.	AU
	Rounde	A TAX TELES	
□ Sub-Rounded □ Well Rounded	Kouriue	u 8	///
Embededness (%):	1,	A	//
Subpavement:	,		Ć
	[Pel	oble ABC ax	cis guide]
Parent Material Bed Coverage (%)		-	
Sorting (Table 20): Well Modera	ate 🗆 P	oor 🗆 Ve	ery poor
Sediment Transport	Sign March		
□ Obsv ☑ Not Obsv □ Not Visible - R	Reason:		
If Observed (Table 21):	ug sa d		
□ Suspended □ Sliding □ Rolling	☐ Sal	tation	
Percentage of Bed Active (%):			
Velocity			
☐ Measuredm/s Method: _		Vhar	<u> </u>
Ø Estimated ♥ O U m/s XS ID:		7177	17 15
Distancem Time		tolk er	m/s
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Distance m Time	s V		m/s
Discharge			
☐ Estimatedm³/s Method: _		dell or	neili.
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	_m V ₆₀	The same of the sa	_m/s
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Version #4 Last edited: 2025-03-04

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Page __1_ of _2__



Project Number: 25011 **Bank Characteristics** x55 Cross-section: Date: 2025-07-09 MC3 Reach: 3:19 Time: Richmond, ON Location: sunny 28'C Weather: Watershed/Subwatershed: RIVER JOCK Field Staff: **Sketch (Viewed Downstream)** Include: measurements, bank slope, evidence of geomorphic processes/adjustments, geomorphic/bedform units, vegetation type & location, bed & bank materials, approx. water level, evidence of erosion, stratification in bank sediments, soil horizons, bankfull indicators, woody debris, roots, etc. Right Bank Left Bank enpegged 8cm belov 5ilt bea **Right Bank Materials Left Bank Materials Features** ☐ Bedrock 🗹 Gravel 只 Station location ☐ Bedrock □ Gravel ☐ Small Cobble □ Till Monumented XS ☐ Small Cobble □ Till ☐ Large Cobble ☐ Clay 0 Monumented photo ☐ Large Cobble ☐ Clay ☐ Small Boulder Undercut bank ⊠ Silt ☐ Small Boulder ₹ Silt ☐ Large Boulder 1111111 Eroded bank/slope □ Sand ☐ Large Boulder ☐ Sand 0.9 XXXXX Bank stabilization Bank Height: m Bank Height: m 0 Bank Angle: Fence *-*-X Bank Angle: Root Depth: m Grasses Root Depth: m WWW % Root Density: Leaning tree % ->> Root Density: m Undercut: Tree Undercut: m Erosion Pin: m * * * Woody Debris Erosion Pin: m kg/cm² Torvane: Sediment sample Torvane: kg/cm² kg/cm² Penetrometer: Erosion pin kg/cm² ШШ Penetrometer: 8 Foot Used: ☐ Yes ☒ No Scour/bed chain ☐ Yes 🗵 No Foot Used: **Additional Notes** Photos: Completed by: _____ Checked by: _ Senior staff sign-off (if required): _____ Version #4

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Detailed Cross-Section Characteristics Project Number: 250

Date:	2025-07-09	Cross-sect	1011;	720	
ſime:	3:35	Reach:		MC3	
Veather:	Sunny 28°C	Location:		Richmond, on	
ield Staff:	KE HM	Watershed	//Subwatershed:	Jock River	
	PC VIII	The state of the s	N 18 11 11 11 11 11 11 11 11 11 11 11 11		
		Notes	Cross-sectiona	I Morphology (Table 2	!2)
			□ Riff	le 🗆 Pool 💢 Run	□ Other
			Substrate Sam	iple:	
	(1) X ()		□ Bed □ E	Bank □ Subpavement □	Water ☒ None
R	112		Pebble Count I	Measurements A/B/C	Axes (cm):
	01600			A B C A B	C A B C
	11900		FINOS	\11 21	131
			12	- 12 22	32
			3	13 23	33
			4 4 4	14 14 14 24 24	24 34 34 34
			15	15 25	35
			6	16 26	36
			7	17 27	/ 37
			8 8 8	18 18 18 28 18	23 38 3 3
				-W/	
			- W	- W	- V-0
			Particle Shape	Platy □ Ver	y Angular
			☐ Sub-angular	Professional of the contraction	unded
				d □ Well Rounded	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
			Embededness ((X X)
			Subpavement		C
			the second secon	Bed Coverage (%)	[Pebble ABC axis guide
	A CONTRACTOR OF THE CONTRACTOR			20): □ Well □ Moderate	The last terms of the second o
		22 063 90	Sediment Trai		, _ , _ , , , _ , , , , , , , , , , , ,
				Obsv □ Not Visible - Rea	ason:
			If Observed (☐ Sliding ☐ Rolling [☐ Saltation
		i i i i i i i i i i i i i i i i i i i	ATTEMPT AMERICAN		_ Saltation
	Printer Countries			Bed Active (%):	
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30 , L	viened self	0.000 [0.000]	The state of the s	m/s Method:	
	tuprabnu		The second secon	m/s XS ID:	
M. L.	19.000.00	F Debris		m Time	
		l Mornes desi		m Time	
manual L		1119 6	Distance	m Time	_s Vm/
	7 Y Y DORUGETH -	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Discharge		
			The state of the s	m³/s Method:	
				m³/s XS ID:	
			Depth	_m Widthn	n V ₆₀ m/s
			1	Milable	
			Depth	m Widthnm Widthn epth < 0.75 m and V20 / V80	n V ₆₀ m/s

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Date:	cteristics		roject Number: 2		-1	
Time:	3:35		Reach:		26	
Weather:	28°C sunny	1			103	
Field Staff:	KC HN		Location:		zichmond, ON	***
		measurements hard	Watershed/Subwa	itershed:	dock River	
ocation, bed & bank	materials, approx. water le	vel, evidence of erosion	slope, evidence of geomorphic , stratification in bank sediment	processes/adjustmen s, soil horizons, bank	its, geomorphic/bedform units	, vegetation ty
12/05 12/07	9105585 128 V 139 Cm 10 Cm 511+ 1	5 c c bc c	x 511+	-910.55 -70'	Right Bank	
Left	Bank Materials		Features		Right Bank Materi	als
☐ Bedrock ☐ Till ☐ Clay ☐ Silt ☐ Sand ☐ Bank Height: ☐ Bank Angle: ☐ Root Depth: ☐ Root Density: ☐ Undercut:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ Large Houlder	m	Monumented XS Monumented phot Undercut bank Eroded bank/slope Bank stabilization Fence Grasses Leaning tree Tree Woody Debris	Silt San Bank H Bank Root I Root De Und	Small Cobb	ole der

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Page <u>2</u> of <u>2</u>



Detailed Cross-Section Characteristics

Project Number: 25011

Cross-section:

Date:		2025	07-09		Cross-sec	tion:				XS	7						
Time:		3:4			Reach:					MC3							
Weather:			28°C		Location:					Rich	mor	nd, DI	N				
Field Staff:			1M			ershed/Subwatershed: Jock RIVET								. de	794		
rielu Stair.		100 1								000	E 4 1507						
					Notes	Cro	ss-se	ectio	nal M	orph	ology	y (Tal	ole 22	2)			
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						Sub	stra	te Sa	mple	:							
							□В	ed 🗆	Bank	⟨ □ S	ubpa	vemer	nt 🗆 V	Vate	r Z N	lone	
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Bank Characteristics

Project Number: 2501

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Page ____2of _2__

Date:	2025-07-09	Cross-section:	F3x
Time:	3:47	Reach:	MC3
Weather:	28°C sunny	Location:	Richmond, ON
Field Staff:	KC HM	Watershed/Subwatershed:	Jock DINER
Sketch (Viewed location, bed & bank	Downstream) Include: measurements, ba	nk slope, evidence of geomorphic processes/adjus sion, stratification in bank sediments, soil horizons,	
	Left Bank	son, stratification in bank sequinents, soil norizons,	bankfull indicators, woody debris, roots, etc.
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	10,00		
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The first control of the second of the secon			
Left	Rank Matorials		
	Bank Materials	Features	Right Bank Materials
□ Bedrock	□ Gravel	只 Station location □	Bedrock □ Gravel
☐ Bedrock	☐ Gravel ☐ Small Cobble	R Station location Monumented XS	Bedrock ☐ Gravel Till ☐ Small Cobble
□ Bedrock □ Till □ Clay	□ Gravel □ Small Cobble □ Large Cobble	Station location Monumented XS Monumented photo	Bedrock ☐ Gravel Till ☐ Small Cobble Clay ☐ Large Cobble
□ Bedrock □ Till □ Clay ☑ Silt	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder	Station location Monumented XS Monumented photo Undercut bank	Bedrock ☐ Gravel Till ☐ Small Cobble Clay ☐ Large Cobble Silt ☐ Small Boulder
□ Bedrock □ Till □ Clay ☑ Silt	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope	Bedrock
□ Bedrock □ Till □ Clay ☑ Silt □ Sand	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ Large Boulder	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Bar	Bedrock
☐ Bedrock ☐ Till ☐ Clay ☑ Silt ☐ Sand Bank Height:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ M	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Bai Fence Bank	Bedrock
☐ Bedrock ☐ Till ☐ Clay ☑ Silt ☐ Sand Bank Height: Bank Angle: Root Depth: Root Density:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ Large Boulder □ m ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Bank Fence Grasses Ro	Bedrock
☐ Bedrock ☐ Till ☐ Clay ☐ Silt ☐ Sand Bank Height: Bank Angle: Root Depth: Root Density: Undercut:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ Large Boulder □ m ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Fence WWW Grasses Leaning tree Roo	Bedrock
☐ Bedrock ☐ Till ☐ Clay ☑ Silt ☐ Sand Bank Height: Bank Angle: Root Depth: Root Density: Undercut: Erosion Pin:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Fence Grasses Leaning tree Tree	Bedrock
☐ Bedrock ☐ Till ☐ Clay ☑ Silt ☐ Sand Bank Height: Bank Angle: Root Depth: Root Density: Undercut: Erosion Pin: Torvane:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Fence Grasses Leaning tree Tree	Bedrock
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☐ Bedrock ☐ Till ☐ Clay ☑ Silt ☐ Sand Bank Height: Bank Angle: Root Depth: Root Density: Undercut: Erosion Pin: Torvane: Penetrometer:	□ Gravel □ Small Cobble □ Large Cobble □ Small Boulder □ Large Boulder □ M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Station location Monumented XS Monumented photo Undercut bank Eroded bank/slope Bank stabilization Fence Bank Grasses Leaning tree Tree X X Woody Debris Sediment sample Erosion pin Pene	Bedrock Gravel Till Small Cobble Clay Large Cobble Silt Small Boulder Sand Large Boulder nk Height: m oot Depth: m th Density: % Undercut: m Torvane: kg/cm² ktrometer: kg/cm²
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Detailed Cross-Section Characteristics Project Number: 250

Date:	2025-07-09	Cross-section:	X38	
Time:	16.00	Reach:	MC3	
Weather:	Sunny 28°C	Location:	Richmond, ON	
Field Staff:	KC HM	Watershed/Subwatershed:	dock piver	

				Notes	Cross-sectional Morph	ology (Table 2	22)	
RTK-	PMZEDII				□ Riffle □ F	Pool KRun	□ Other	-
	Pt starts A	800			Substrate Sample:			
		39			□ Bed □ Bank □ S	Subpavement 🗆	Water 🗔	None
					Pebble Count Measure	ments A/B/C	Axes (cr	n):
**************************************					A B C A B	C A B	CA	ВС
· · · · · · · · · · · · · · · · · · ·					FINCS	21		31
					12 2	22		32
					3 3	23		1 22
					4 4 4 14 4	14 24 24	24 34	34 34
					15	25	L	35
					16	126		36
					~ - 7 / 17	127		37
					8. 18 8 18 18	18 28 28	28 38	38 38
						1	!	1
								U
			-	+	Particle Shape: Platy	/ □ Ver	y Angular	
					☐ Sub-angular ☐ Angu			
					☐ Sub-Rounded ☐ Well		maca	> ///
					Embededness (%):		A	$\mathcal{X}/$
				-	Subpavement:		<u></u>	C
	Local Planes in	5 F		2500()	Parent Material Bed Cove			C axis guide]
		Atome 9		00000000	Sorting (Table 20): □ W			Wery noor
	STUGA MERCE			CA 000(1811)	Sediment Transport	ell 🗆 Moderate	1 FOOI L	yery poor
		You						
		100		annet year o	□ Obsv ☑ Not Obsv □ N		son:	
				la de la colonia de la colonia de la colon	If Observed (Table 21):		Caltation	e a 5 1
		- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	R		☐ Suspended ☐ Sliding		Saltation	101
	, , , , , , , , , , , , , , , , , , , ,	edresić stari		<u> </u>	Percentage of Bed Active	? (%):		
		dicad no.		28 23	Velocity			
, X	147	ghameu jo	4.9	56717040	☐ Measuredm			A CONTRACTOR OF THE PARTY OF
		te producti			☐ Estimated	The state of the s		
. 174		48 Bulksa		20031140	Distancem 1		THE PERSON NAMED IN COLUMN	m/s
				38 (1) 100 11 12 14	Distancem 1			m/s
		17917819.41109		2763 10 /0	Distancem 1	Time	_s V	m/s
					Discharge			
					Estimatedm ³			
					☐ Measuredm			
					Depthm Widt	- Charleston		
					Depthm Widt		CONTRACTOR OF THE PARTY OF THE	
					Depthm Widt	hm	V ₆₀	m/s
	cva betakmo.	i id b	ruberio		Use V_{60} if Depth < 0.75	5 m and V_{20} / V_{80} i	f Depth >	0.75 m

Version #4 Last edited: 2025-03-04

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Bank Charac	teristics		Proje	ct Number: 25	10	1		M O R P H I X*
Date:	2025-07-0		To Section	oss-section:		XS8	refre	
Time:	16:06		Re	each:		MC3		
Weather:	Sunnu 28	No.	Lo	cation:		Richmon	id, ov	
Field Staff:	KE HM	2 22	W	atershed/Subwatersh	ed:	dock 1	River	
Sketch (Viewed	Downstream) Include:	measurements, bank	c slope, e	evidence of geomorphic processes	s/adjustm	ents, geomor	phic/bedform units, veg	etation type &
	Left Bank						_	
							(01)	Wall
						- 4	Lrvb5	A
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	MA							
	2111	M		3- 5:17				
	10/2		10	5cm				
	(66b)	5,1+	15					
		deo	p					
Left	t Bank Materials			Features		Righ	t Bank Materials	
☐ Bedrock	☐ Gravel		只	Station location		Bedrock	☐ Gravel	12
□ Till	☐ Small Cobble		_	Monumented XS			☐ Small Cobble	
☐ Clay	☐ Large Cobble		0	Monumented photo			☐ Large Cobble	
Silt	☐ Small Boulder			Undercut bank	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		☐ Small Boulder	
☐ Sand Bank Height:	☐ Large Boulder		 	Eroded bank/slope	1	Sand	☐ Large Boulder	
Bank Angle:	707		*	Bank stabilization Fence		k Height:	15	m •
Root Depth:	0.05		WWW WWW	Grasses	1	nk Angle: ot Depth:	0.09	
Root Density:	5	%	₩ W	Leaning tree	1	Density:	10	— m — %
Undercut:		m		Tree	0,500	Indercut:	0	/0 m
Erosion Pin:			× ×	Woody Debris		osion Pin:		m
Torvane:		kg/cm²		Sediment sample	1	Torvane:	0,25	kg/cm ²
Penetrometer:	0.35			Erosion pin		rometer:	0.25	kg/cm ²
Foot Used:	□ Yes 🗵 No		8	Scour/bed chain		oot Used:	☐ Yes ☑ No	3,
Additional Not	es , , , , , ,							
		e5 " - 5					10 TO	
Photos:								

Version #4

Last edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Page ____2 of ____

Appendix D: Detailed Assessment Data Summaries



Detailed Geomorphological Assessment Summary

Marlborough Creek, Reach MC3

Project Number:	PN25011	Date:	2025-07-09
Client:	Tamarack Homes / Taggart Group	Length Surveyed (m):	313.7
Location:	Richmond, ON	# of Cross-Sections:	8

Reach Characteristics

Drainage Area: 5.665 Dominant Riparian Vegetation Type: Trees and srhubs

Geology/Soils: Fine textured glaciomarine deposits Extent of Riparian Cover: Continuous

Surrounding Land Use: Forested Width of Riparian Cover: 1-4 right bank, >10 left bar

 Valley Type:
 Partially Confined
 Age Class of Riparian Vegetation:
 Established

 Dominant Instream Vegetation Type:
 Floating/ Rooted Emergent
 Extent of Encroachment into Channel:
 Minimal

Portion of Reach with Vegetation: 85% Density of Woody Debris: Moderate

Hydrology

Estimated Discharge (m³/s):

Modelled 2-year Discharge (m³/s):

Modelled 2-year Velocity (m/s):

N/A

Stimated Bankfull Velocity (m/s):

N/A

0.66

Estimated Bankfull Velocity (m/s):

0.73

Profile Characteristics

Bankfull Gradient (%): 0.49
Channel Bed Gradient (%): 0.28
Riffle Gradient (%): No riffle/pools
Riffle Length (m): No riffle/pools
Riffle-Pool Spacing (m): No riffle/pools

Planform Characteristics

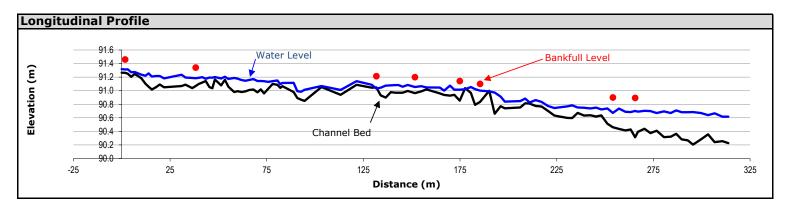
Sinuosity: 1.14

Meander Belt Width (m): See Report

Radius of Curvature (m): Straightened Channel

Meander Amplitude (m): Straightened Channel

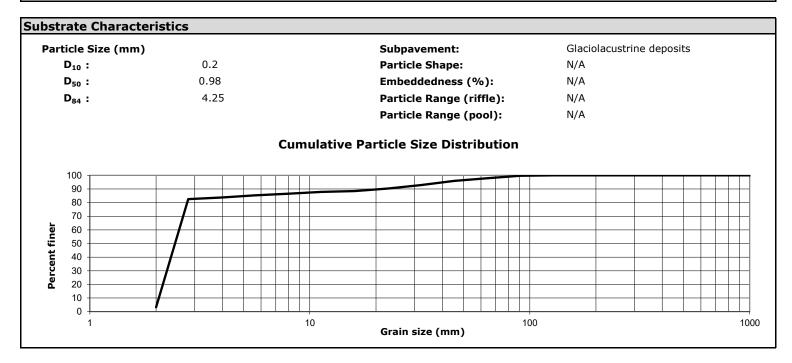
Meander Wavelength (m): Straightened Channel



Bank Characteristics								
	Minimum	Maximum	Average		Minimum	Maximum	Average	
Bank Height (m):	0.35	2.00	0.80	Penetrometer Value (kg/cm3):	0	1.25	0.4	
Bank Angle (deg):	1	35	17	Bank Material (range):	CI	ay/Silt to Grave	el	
Root Depth (m):	0.03	0.20	0.10					
Root Density (%):	5	30	15					
Bank Undercut (m):	0.00	0.07	0.00					

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	Minimum	Maximum	Average	47.7 少量。	
ankfull Width (m):	3.01	6.85	4.13	一类。这是	
verage Bankfull Depth (m):	0.06	0.25	0.22	全国的企业	
Bankfull Width/Depth (m/m):	16	65	28		Se 1
Vetted Width (m):	0.30	3.14	2.22		10 2 2 1
verage Water Depth (m):	0.01	0.20	0.08		
etted Width/Depth (m/m):	15	126	46		
ntrenchment Ratio (m/m):	>2.2 (Slig	ht/Low Entrend	chment)	三型型等 。	
laximum Water Depth (m):	0.02	0.35	0.14	10000000	
Manning's <i>n</i> :		0.040		·大家等人	Single 4.
		Danrasar	stative Cross	Photog	graph at cross sectio
93.0		Represer	ntative Cross	s-Section 4	graph at cross sectio
93.0		Represer	ntative Cross	s-Section 4	graph at cross sectio
93.0		Represer	ntative Cross	s-Section 4	graph at cross sectio
92.5		Represer	ntative Cross	s-Section 4	graph at cross section
92.5	Double 1		ntative Cross	s-Section 4	graph at cross section
92.5	Bankfu	Represer	ntative Cross	s-Section 4	graph at cross section
92.5	Bankfu		ntative Cross	s-Section 4	graph at cross section
92.5 Elevation (a) 92.0 91.5	Bankfu		ntative Cross	s-Section 4	graph at cross section
92.5	Bankfu		ntative Cross	s-Section 4	



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Channel Thresholds			
Flow Competency (m/s):		Tractive Force at Bankfull (N/m ²):	10.56
for D ₅₀ :	0.20	Tractive Force at 2-year flow (N/m ²):	N/A
for D ₈₄ :	0.38	Critical Shear Stress (D ₅₀) (N/m ²):	0.71
Unit Stream Power at Bankfull (W/m²):	8		

General Field Observations

Channel Description

The subject reach of Marlborough creek in Richmond, MC3, was characterized by a sinuous channel set within a partially confined, wooded valley. The dominant riparian vegetation consisted of established trees and shrubs which provided some cover over the channel. Channel bed morphology consisted of a lack of riffle-pool sequences and was relatively planar. The channel exhbited evidence of systemic aggradation as sedminent depths gradually increased in the downstream extents of the channel. Riparian vegetation along the right bank was limited to 1-4 channel widths due to the railway which acted as the right bank valley wall, while the left bank riparian vegetation extend over 10 channel widths past the bank which consisted of established forest.





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Appendix E: Erosion Exceedance Hydrographs

